Electrical World

MAR 13 1945

MARCH 3, 1945

TVA Kentucky Project

High Frequency Power Setting

Lockout Relays Prevent Substation Trip-Out

Simplify TEST PROCEDURE

with these versatile WESTON Test Instruments

The Multi-Purpose, Super-Sensitive Analyzer

(MODEL 772)

A compact and practical wide-purpose instrument with sensitivity of 20,000 ohms per volt, on dc ranges.

Ranges – all self-contained

Voltage, a-c and d-c – 0-1000/250/50/10/2.5.

Current, d-c – 0-10/1 amps. – 0-250/50/10/1 milliamps. and 100 microamps.

Ohms – Full Scale – 30/3 megohms – 30,000/3000 ohms. Center Scale – 250,000/25,000/250/25 ohms.

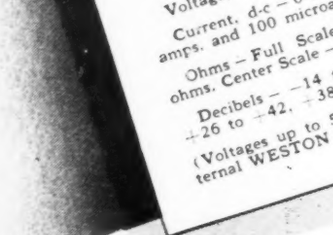
Decibels – −14 to +2; −2 to +14, +12 to +28, +26 to +42, +38 to +54.

(Voltages up to 5000 dc available through use of external WESTON Televerter, Model 766.)

The Direct-Reading, Self-Contained INSULATION TESTER

(MODEL 796)

This compact direct-reading resistance tester eliminates hand cranking and thus makes leakage testing a simple one-man job especially in unaccessable places. Tests up to 200 megohms at test potential of 350 to 500 volts d-c; although, the current at terminals is only a few microamperes. Operates from long life, light-weight batteries. There are no vibrators to replace. Ranges: 0-20-300 megohms full scale; 0-.5-5 megohms center scale. Size 8" x 9⅛" x 8".



The Industrial Circuit Tester

(MODEL 785)

Recognized as the most complete unit for routine maintenance tests, and for testing needs which require an ultra-sensitive instrument.

Ranges all self-contained

D-C VOLTAGE . . . Six Full Scale Ranges of: 1/10/50/200/500/1000 volts (20,000 Ohms per volt).

A-C VOLTAGE . . . Six Full Scale Ranges of: 5/15/30/150/300/750 (1,000 Ohms per volt).

D-C CURRENT . . . Six Full Scale Ranges of: 50 Microamps . . . 1/10/100 Milliamps. . . . 1/10 Amps. (Higher ranges, at half scale reading, with 100 mv. external shunts).

A-C CURRENT . . . Four Full Scale Ranges of: .5/1/5/10 Amperes. (Higher Ranges with external current Transformers.)

RESISTANCE . . . Five Full Scale Ranges of: 3,000/30,000/300,000 Ohms . . . 3/30 Megohms. Center Scale Values . . . 25/250/2,500/25,000/250,000 Ohms. (Self-Contained Batteries)

With production currently running slightly ahead of war requirements, a limited number of the popular WESTON test instruments shown herewith are available and are offered subject to prior sale. Orders can be placed direct, or with the WESTON representative in your vicinity. Literature available from...WESTON Electrical Instrument Corporation, 578 Frelinghuysen Avenue, Newark 5, New Jersey.

WESTON
INSTRUMENTS

Electrical World

FOUNDED IN 1874 • READ BY ELECTRICAL MEN FOR 71 YEARS

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POWER and FEEDER CIRCUIT CABLES PROTECTED by HAZAKROME

HAZAKROME, a thermoplastic synthetic resin, has become recognized as highly satisfactory insulation since its introduction more than five years ago.

Hazakrome contains no rubber, although it possesses many of its desirable characteristics. Its non-flammability makes it definitely superior to rubber. Its smooth surface is resistant to oil, moisture, acids and alkalies, ozone and continued exposure to the atmosphere. This makes Hazakrome a highly desirable insulation for low voltage light and power circuits up to 600 volts, and for underground cable for series lighting circuits up to 5000 volts.

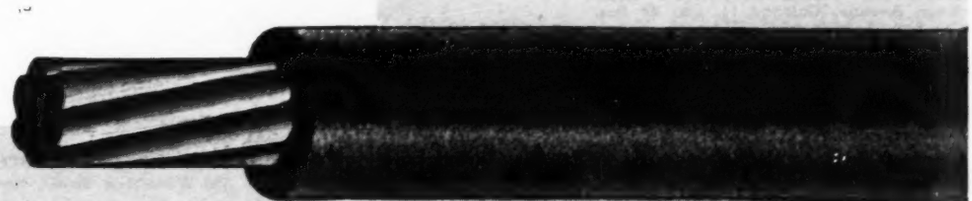
Hazakrome is ideal for installation in ducts and raceways because of its toughness and its smooth surface.

For direct burial in the ground further protection is provided by the addition of tape, and flame and moisture resistant braid. Multiple conductors, separately insulated with Hazakrome, can be cabled together and encased in a Hazakrome armor sheath. Hazakrome Underground Cable meets all the requirements of Civil Aeronautics Administration. Specification No. 538.

Types SN and SNW Building Wire

Type SN Hazakrome Building Wire has the big advantage of small diameter. No fabric covering is necessary because the smooth surface of the insulation resists all deteriorating influences.

Type SNW Hazakrome Building Wire is the moisture-resistant grade approved by Underwriters' Laboratories for wet locations in place of Lead Encased Cable as provided in Section 3035 of the National Electrical Code. Hazard Insulated Wire Works, Division of The Okonite Company, Wilkes-Barre, Pa.



HAZARD

insulated wires and cables for every electrical use

3990

LITTLE DID WE KNOW, these 12 years while we were saying, "Electroline Automatic Line Splices are reclaimable" that the really big story had not yet been told.

Now this important reclaimable feature scores again. Vital materials from which Automatic Line Splices are made are mostly off to war . . . so it is impossible to supply the quantity of line splices we would like to but your stock bins will supply splices for immediate requirements.

Every "out of service" line equipped with Electroline Automatic Line Splices is a source of supply. These splices are reclaimable.

Electroline Splices can be removed in a jiffy. Back they go to stock bins for re-use . . . time and time again. Stock without stock expenditures. How's that for an "extra" dividend?

It is the everlasting quality of Electroline products that assures our users of adequate, effective usable Automatic Line Splices for the duration. The quality is there because long experience in this field has taught us how to put it there. Not only the first Automatic Line Splice, but also the first Reclaimable Line Splice came from the house of Electroline.

Electroline Company

Originators and Patentees of Automatic Line Splices and Dead Ends

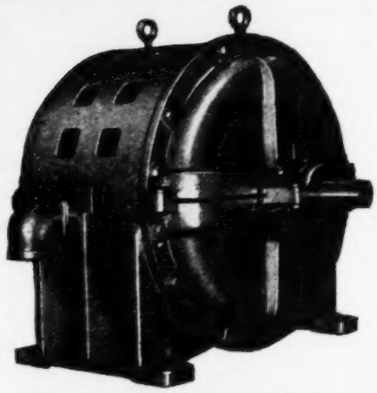
4121 SOUTH LA SALLE STREET • CHICAGO 9, ILLINOIS

CRAFTSMANSHIP COUNTS!

THIS huge Elliott motor stator and frame is destined for the main propulsion drive of a Maritime Commission vessel.

It is a nice job of motor building. The fabricated frame is exceptionally rigid. Form-wound coils made of transposed strands improve efficiency and reduce heating. The coils are insulated with mica tape and impregnated with a special insulating compound. These coils form a single turn series wave winding, with all connections at one end. This arrangement provides for easy emergency repair should it be necessary, as a damaged coil can be cut out of the circuit by opening the connections and inserting jumpers.

This motor develops 6600 hp. at 93 r.p.m. Its size is a measure of Elliott engineering capacity. Its craftsmanship is characteristic of all Elliott motors, large and small.



When you need a quality motor, come to Elliott.

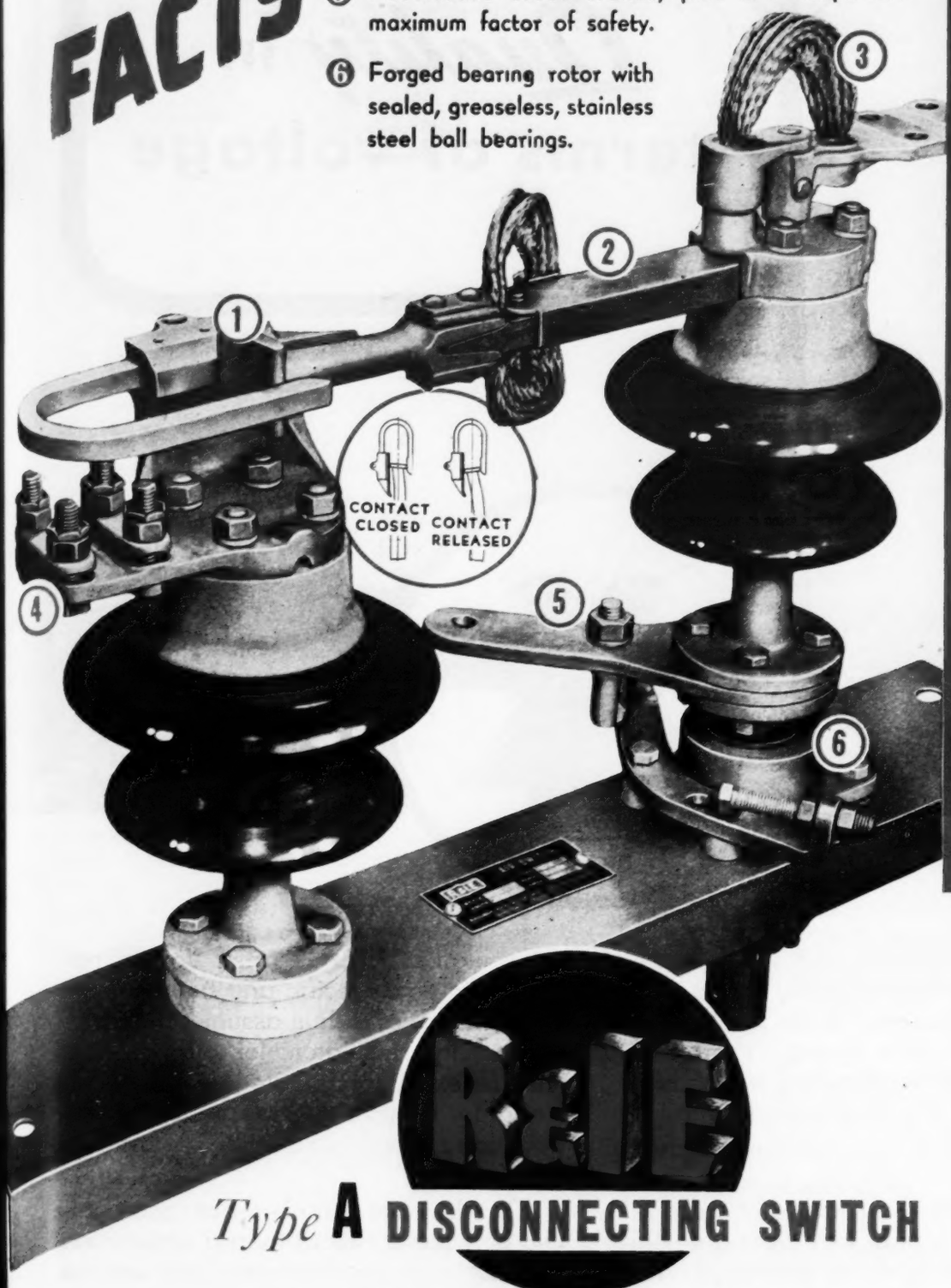
OTHER PRODUCTS:
STEAM TURBINES • GENERATORS MOTORS • CONDENSERS • FEEDWATER HEATERS AND DEAERATORS • STEAM JET EJECTORS • CENTRIFUGAL BLOWERS • TURBOCHARGERS FOR DIESEL ENGINES • TUBE CLEANERS STRAINERS • DESUPERHEATERS • FILTERS

ELLIOTT *Company*
Electric Power Dept.
RIDGWAY, PA.
DISTRICT OFFICES IN PRINCIPAL CITIES

L-752

CHECK the FACTS

1. Hi-Pressure, self-cleaning contact.
2. Rectangular section, high conductivity copper blade. Positive-action toggle provides contact cleaning with each operation.
3. Correct mechanical design of flexible connection assures trouble-free service throughout the life of the switch.
4. Four half-inch bolt, clamp type, terminals.
5. Fabricated steel cranks, pins and stops for maximum factor of safety.
6. Forged bearing rotor with sealed, greaseless, stainless steel ball bearings.



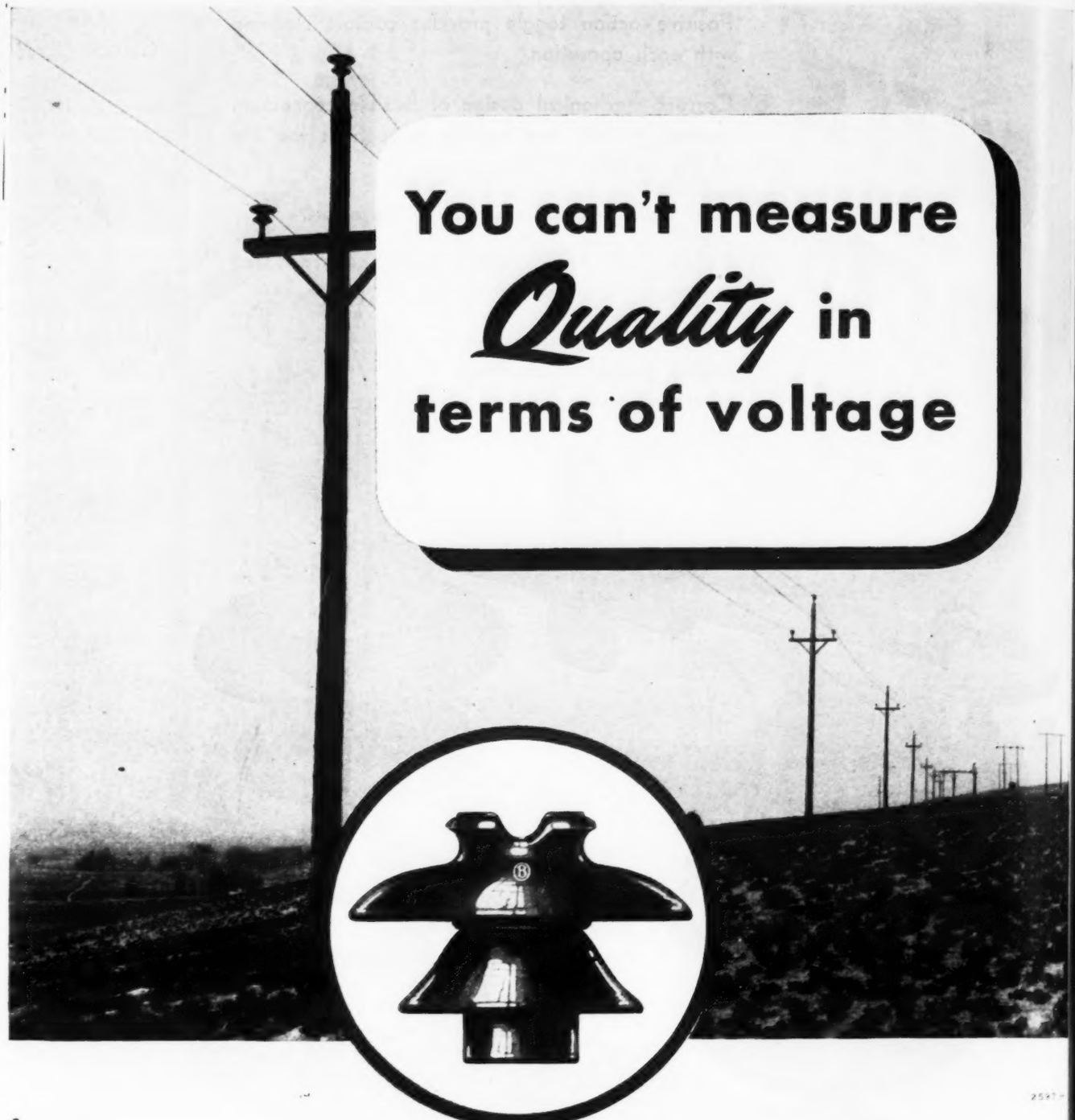
The Check List

- CONDUCTOR SUPPORTS CLAMPS AND FITTINGS
- DISCONNECTING SWITCHES INDOOR AND OUTDOOR
- HORN GAP SWITCHES
- INTERRUPTER SWITCHES
- CUTOUTS AND THERMO-RUPTERS
- SWITCH OPERATING MECHANISMS
- SUBSTATIONS
- OPEN OR ENCLOSED, ISOLATED PHASE HEAVY DUTY BUSES
- KIRK INTERLOCK SYSTEMS
- AUTOMATIC SECTIONALIZING EQUIPMENT
- METAL CUBICLES
- TESTING DEVICES

R&IE

Type **A DISCONNECTING SWITCH**

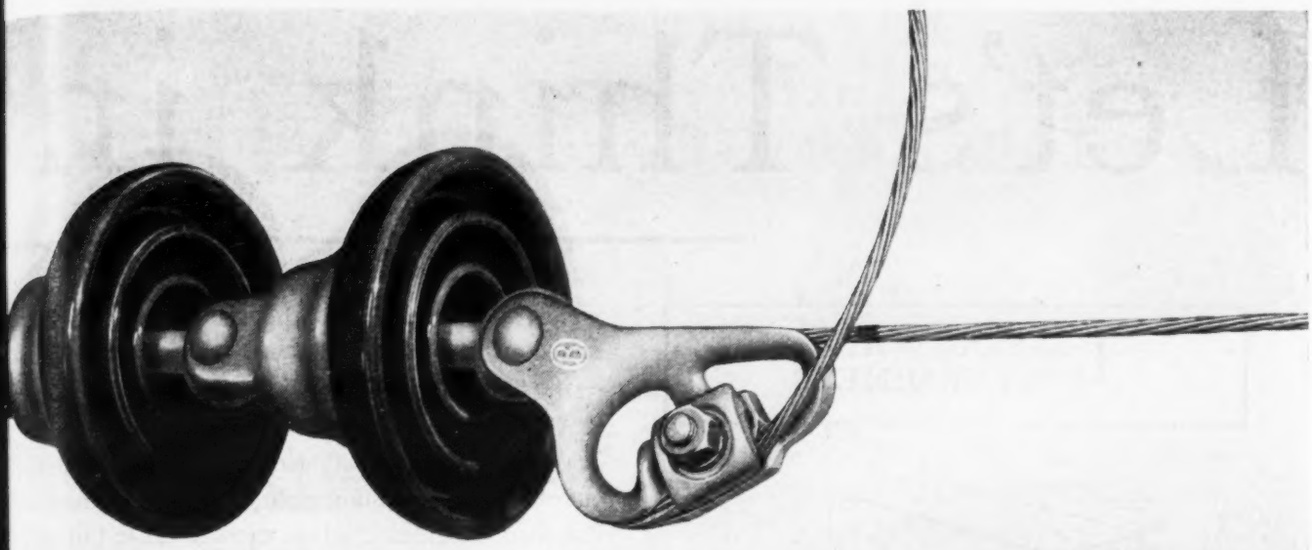
RAILWAY AND INDUSTRIAL ENGINEERING CO., GREENSBURG, PA.
IN CANADA—EASTERN POWER DEVICES, LIMITED, TORONTO



IN THE final analysis, low voltage lines are the ones that actually serve your customers. In the eyes of the public, they stand for your whole system. There may be no chance for emergency switching if one goes out -- it's a service interruption.

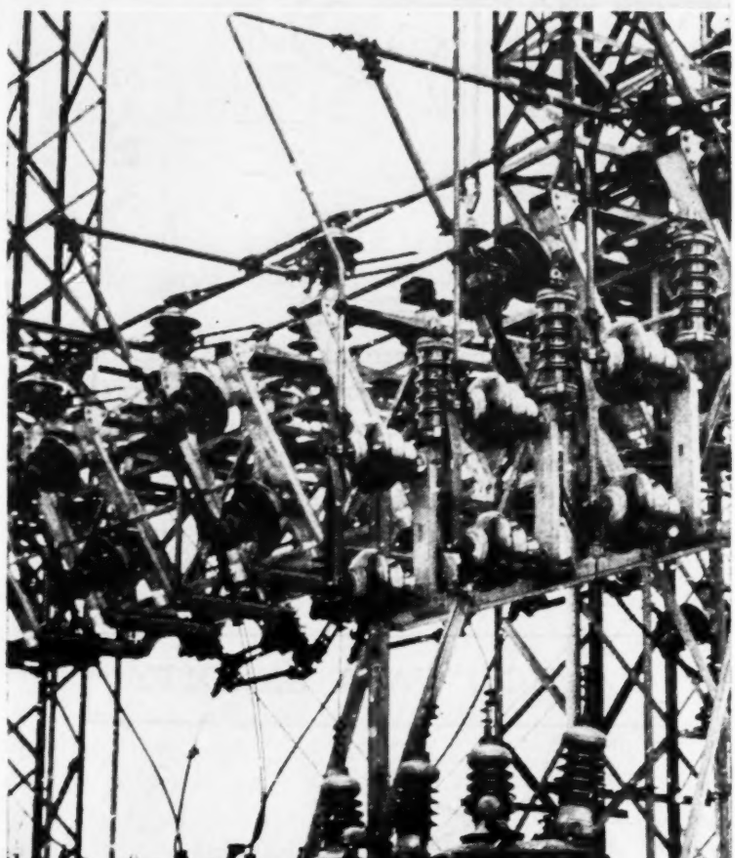
Be this as it may, however, the average low voltage line has strenuous demands put upon it. Usually it operates in exposed locations without ground shielding; a target for lightning discharges. The self-contained pintype insulators constitute a single dielectric unit between line and ground, and thus assume a high responsibility. Insulators for pintype lines must be exceptionally well designed and made to withstand these requirements. You can't measure quality in terms of voltage.

This kind of thinking has gone into O-B pintypes for more than a generation, and accounts for their excellent service.



This combination of 6-inch O-B suspension units and a Universal Strain Clamp puts high-voltage reliability into lower-voltage lines; reduces the need for attention; saves emergency repair runs. Among the three sizes of these O-B clamps, any standard distribution conductor can be accommodated. Clamps will develop cable's ultimate.

While the spectacular apparatus is on the high side of a substation, the fact remains that on the low side, where the power goes out to customers, there may be ten times as many bushings, switches, and buses. The bushings on a power transformer may not be impressive, and the single insulator on an out-going switch or bus may not loom large in comparison to high-voltage stacks, but the work they do is exactly as important. You don't have to go into the higher brackets to get traditional O-B reliability – it's all there in the smaller pieces of station ware. O-B has never measured **quality** in terms of voltage, because you can't measure **trouble** in terms of voltage!



Ohio Brass

MANSFIELD, OHIO, U. S. A.

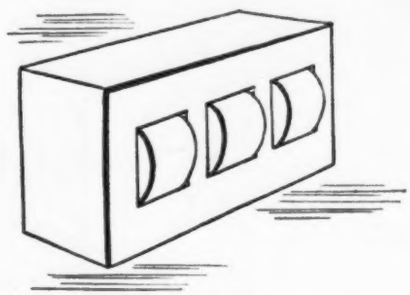
CANADIAN OHIO BRASS CO., LTD., NIAGARA FALLS, ONTARIO

★ ★ KEEP BUYING ★ ★

★ ★ WAR BONDS ★ ★

Let's Think in

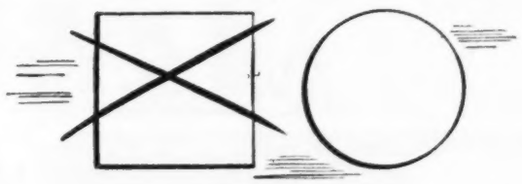
1. YOU WANT STURDINESS



FOR RUGGED electrical duty, Allis-Chalmers uses "shell type" construction on all large, higher voltage power transformers.

Reasons are basic: vertical disc coils give less capacitance to ground . . . more uniform distribution of impulse voltages; solid insulation between coils, combined with vertical oil ducts, gives greatest insulation strength; and the shell type transformer is sturdily braced against over-currents with 80% of the windings enclosed in steel.

2. YOU WANT RIGIDITY

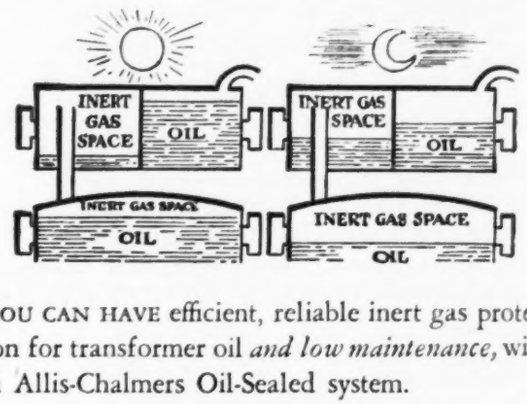


ALLIS-CHALMERS employs circular coil construction on *all* power transformers. Principal reason is that circular coils have uniform strength at all points, since tension on the wire can be maintained while winding with *no snubbing* at corners — no pounding on the conductor.

Also important — a circular coil, unlike an oval or rectangular coil, has no tendency to pull out of shape under short circuit conditions. There's less chance for deformation stress to cause failure.

Thus a round coil shape is naturally best, both from the standpoint of efficient winding and fault-free operation.

3. YOU WANT LOW MAINTENANCE



YOU CAN HAVE efficient, reliable inert gas protection for transformer oil *and low maintenance,* with an Allis-Chalmers Oil-Sealed system.

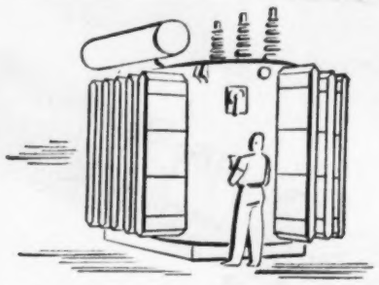
The simple Oil-Sealed system operates at a low pressure — about one pound per square inch. It has no pressure reduction valves or moving parts to wear and cause trouble . . . no gas cylinders to replace.

That's why maintenance on the Oil-Sealed inert gas-protected transformer is not any greater than for a transformer with conventional expansion tank . . . why the Oil-Sealed system is favored by operators.

Invest in ALLIS-CHALMERS

"Simples" ABOUT POWER TRANSFORMERS

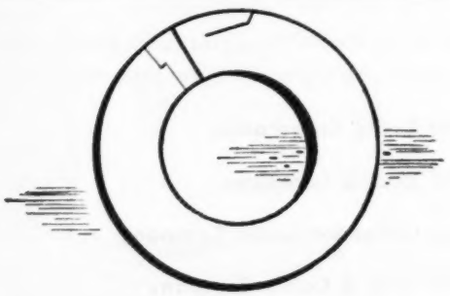
4. YOU WANT CONVENIENCE



THE SIDE of the transformer tank is both the safest and the most convenient location for no-load tap changer operating handles, so that's where Allis-Chalmers puts them.

With the operating handle and position plate at the side of the transformer rather than on the cover, tap positions can be observed *from the ground level* while the transformer is in service. It's easy to change tap positions, too.

5. YOU WANT PROTECTION

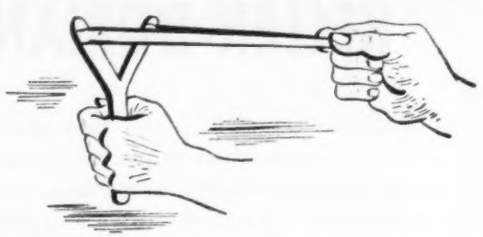


WHILE UNIFORM voltage distribution is built right into the overall design of the shell type transformer, Allis-Chalmers *further* protects high voltage power transformers from destructive surges by a conducting shield connected to the line and placed next to the line-end turns.

The shield is a flat metal disc insulated and installed the same as the coil discs in the transformer. Thus it introduces no points of high stress between the line and turns remote from the line . . . cannot interfere with free oil circulation.

The combination of shell type design and disc shield provides ideal simple surge protection.

6. YOU WANT LONG LIFE



FAST contact separation means short arcing time, less burning, and *longer life* for arcing contacts.

That's the reason why Allis-Chalmers utilizes "quick-break" in the design of load-ratio-control for power transformers.

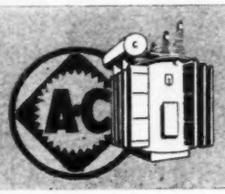
With quick-break design, contacts are *snapped* from one position to the next — much as a stone is snapped from a slingshot. There's no time for burning or arcing on contact surfaces.

Get the full story on sturdy, reliable power transformers from your nearby A-C district office, or write directly to ALLIS-CHALMERS, MILWAUKEE 1, WISCONSIN.

♪ *Tune in the Boston Symphony, Blue Network, every Sat. Eve.*

A 1792

Power Transformers

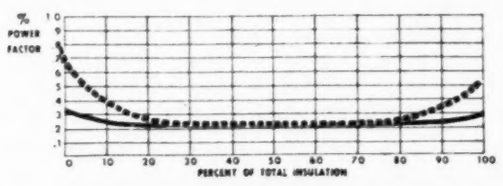


SHIELD OUT *this* POWER THIEF

WITH KELLER-DORIAN METALLIZED PAPER TAPE

Costly corona leaks represent power that never reaches a meter . . . money out of pocket to any utility. Excess corona also speeds cable deterioration and breakdown. That's why cable wrapped with Keller-Dorian Metallized Paper Tape assures longer *and more profitable* service. Serving as an effective electrostatic shield between the insulation and the outer sheath, metallized paper tape *eliminates* corona in spaces between insulation and sheath.

Keller-Dorian Metallized Paper Tape is available in a variety of standard types, or can be tailor-made to your requirements. Specify and buy cable that gives you this important Keller-Dorian corona-proof protection . . . made by the companies listed on this page.



Note the uniformly low radial power factor characteristic obtained with Keller-Dorian Metallized Paper Tape shown by the BLACK curve, and the sharp upswing shown by the BLUE dotted curve when it is not used.

(Chart courtesy Okonite-Callender Cable Co.)

Cable manufacturers offering you cable protected by Keller-Dorian Metallized Paper Tape include:

General Cable Corporation

General Electric Company

Okonite-Callender Cable Company

Simplex Wire & Cable Company

U. S. Rubber Company

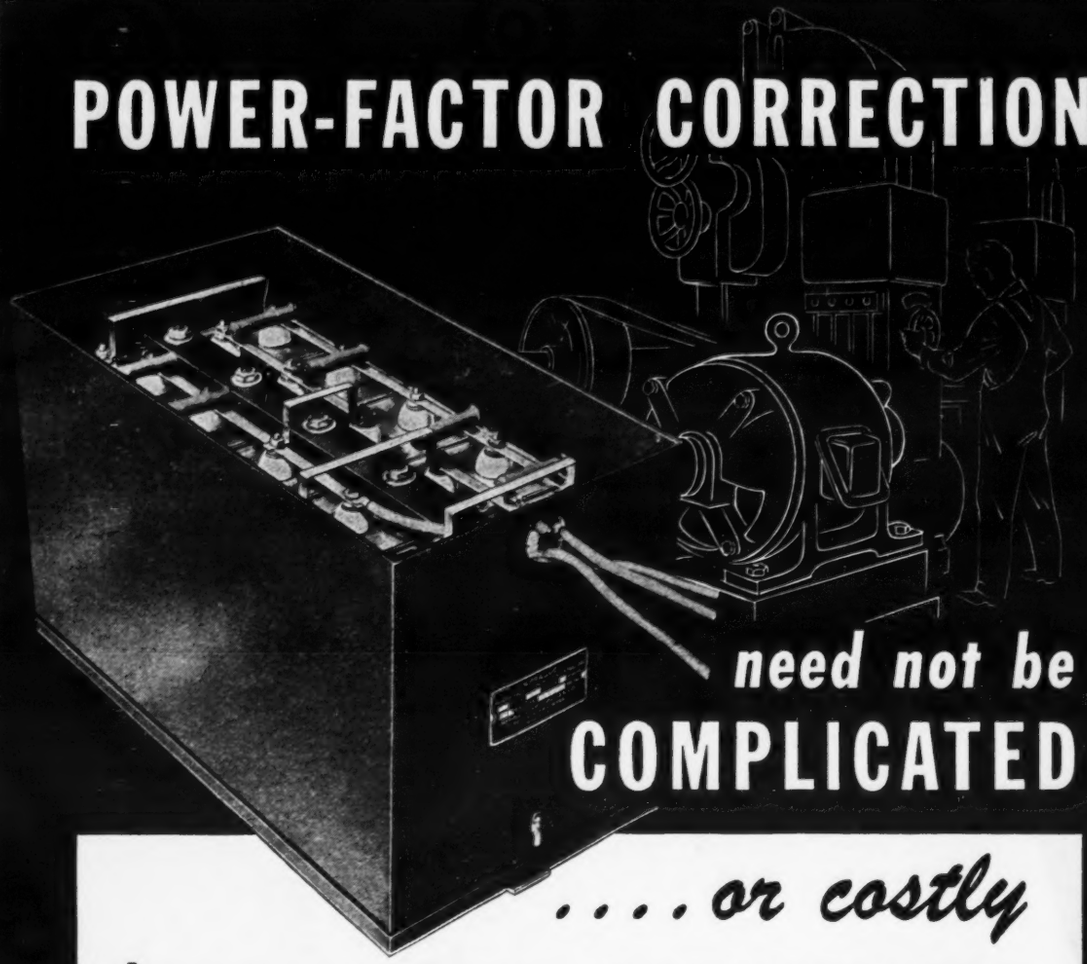
KELLER-DORIAN

CORPORATION

EMPIRE STATE BUILDING, NEW YORK 1, N. Y.

METALLIZED PAPER TAPES FOR ELECTRICAL CABLES AND CONDUCTORS

POWER-FACTOR CORRECTION



need not be COMPLICATED

....or costly

It may come as an agreeable surprise to you to learn how easily and economically Sprague UNIVERSAL Box-Type Capacitors can provide adequate power-factor correction for most motors or other electrical equipment installations. Installed at the equipment itself rather than at the transformer bank they reduce I^2R losses in plant feeders. Available in standard sizes that may be used singly or grouped as required, they afford a quick, inexpensive solution to a wide variety of P.F. correction problems throughout industry, and result in larger savings and better voltage control.

WRITE *for details, including the helpful booklet "Sprague Capacitors for Power-Factor Correction."*

SPRAGUE ELECTRIC CO., North Adams, Mass.

*TRADEMARK REG. U. S. PAT. OFF.

SPRAGUE

CAPACITORS · KOOLOHM RESISTORS

WHAT MUNICIPAL OFFICIALS ARE READING THIS MONTH

Advertisements like this are appearing month after month in municipal magazines. Capitalize on this support. Begin your local promotion of adequate street lighting now.

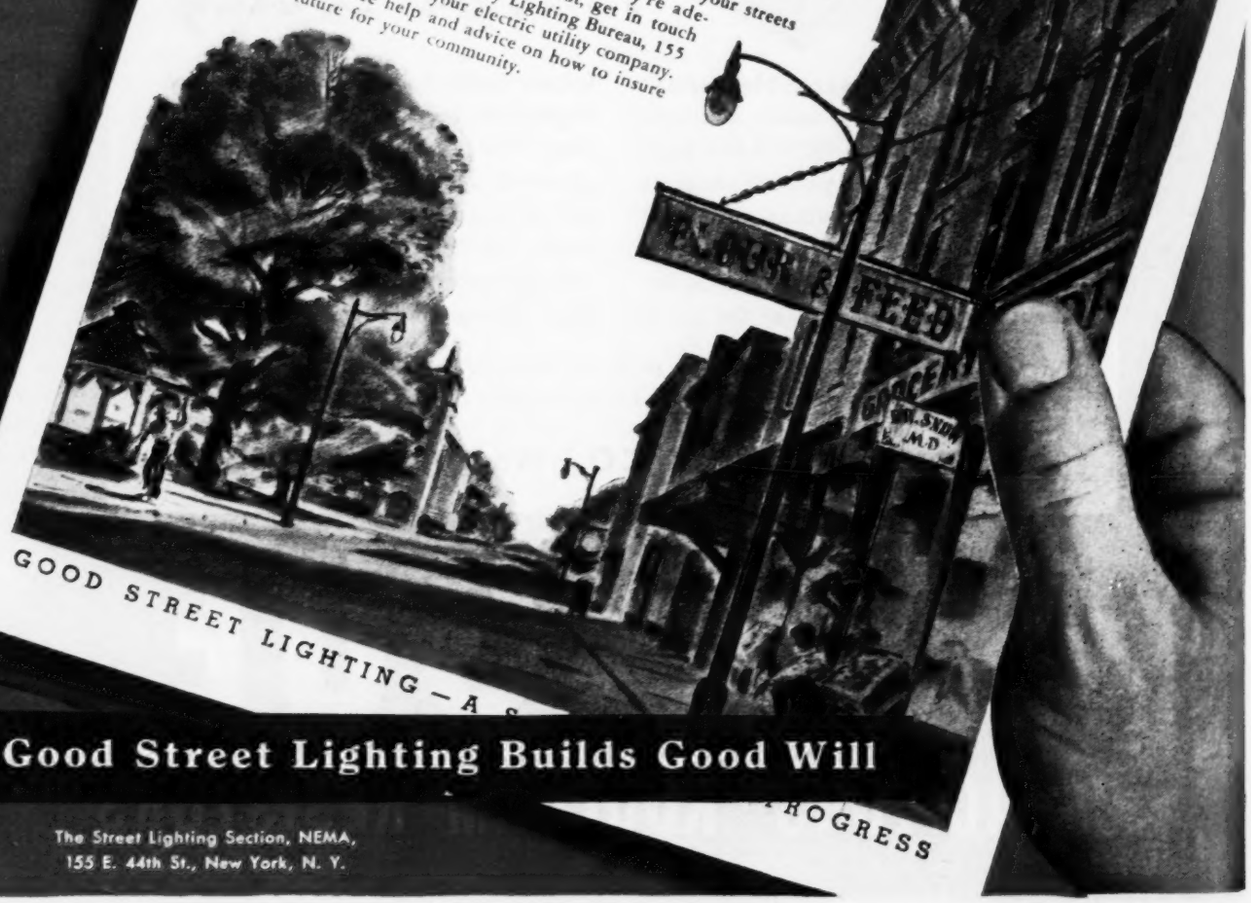
What's wrong with this Picture?

Answer: You won't find a town that's "down at the heels" when its streets are adequately lighted.

YOU'D never be able to photograph a scene like this. It has to be drawn by an artist with a vivid imagination. For you just don't find a sleepy town, depressed citizens and sluggish business where there's adequate street lighting.

It's almost axiomatic — when you modernize street lighting you start in motion a rejuvenation process that leads to greater safety, better business, increased civic pride, more industrial activity and many other civic improvements.

Maybe there's an idea here for you. Why not check your streets tonight and decide for yourself whether they're adequately lighted for postwar needs? If not, get in touch with The Street and Traffic Safety Lighting Bureau, 155 E. 44th St., New York, or your electric utility company. You'll be given free help and advice on how to insure a brighter future for your community.



GOOD STREET LIGHTING — A S... PROGRESS

Good Street Lighting Builds Good Will

The Street Lighting Section, NEMA,
155 E. 44th St., New York, N. Y.

Because of their dual operating characteristics

TYPE "H" KYLE AUTOMATIC

Oil Circuit Reclosers will increase your revenue

Kyle Automatic Oil Circuit Reclosers at strategic points on your lines can be counted on to isolate permanent faults to the shortest possible branches . . . keep the revenue producing current going to the main lines and all unaffected branches.

These dual operating characteristics, as exemplified in the Type "H" Kyle Automatic Oil Circuit Recloser, provide:

1. *Fast Opening* of the Recloser on the *First* and *Second* Operations.
2. *Time Delay Opening* of the Recloser on the *Third* and *Fourth* Operations.

Only a Kyle Automatic Oil Circuit Recloser with these dual operating characteristics will clear all temporary faults and also permit the use of additional sectionalizing devices to isolate permanent line faults.

Advantages of Dual Operating Characteristics

1. All temporary line faults, which comprise 90% of line disturbances are cleared AUTOMATICALLY.
2. Service continuity is increased with resultant higher revenue and better customer satisfaction.
3. Outages are confined to the smallest possible area.

Ask your Line Material Representative to furnish you with complete details on the Type "H" Kyle Automatic Circuit Recloser and how it can be used most effectively to protect your system.

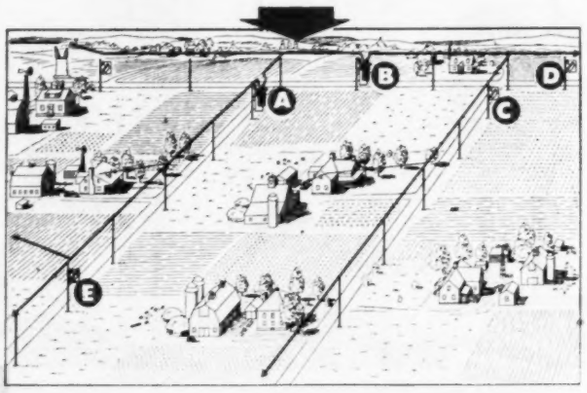
RECLOSER RATINGS: Volts—2400 to 15,000; Amperes—5 to 50; Tripping Current—10 to 100 Amperes; Interrupting Current—150 to 1200 Amperes.

HERE'S HOW IT WORKS:

To protect branch lines from a substation feeder, Kyle Reclosers are located at "A" and "B" to isolate the branches from the main line. Fuses are used on the load side of the Kyle Recloser at "C", "D", and "E" to sectionalize the branch line.

If a fault beyond the sectionalizing fuses is not cleared on the first two operations of the Recloser, it is considered of a permanent nature and the branch line should be isolated by the blowing of the sectionalizing fuse. The Type "H" Kyle Automatic Circuit Recloser permits coordination with the sectionalizing fuse on its third and fourth operations, so that the fuse is blown before the Recloser locks out.

In this way, the line outage is confined to a small portion of the protected system and service is maintained to the remainder of the system.



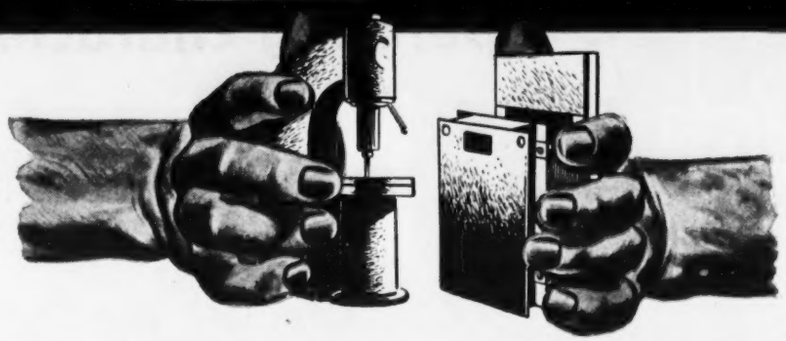
MADE BY KYLE CORPORATION SOUTH MILWAUKEE WISCONSIN

KYLE Circuit Breakers are Designed and Manufactured for LINE MATERIAL COMPANY MILWAUKEE WISCONSIN

BRING THEM TOGETHER

FOR BETTER PERFORMANCE

YOUR MACHINES



AMERTRAN DRY TYPE TRANSFORMERS

Keep every machine at full output. Install AmerTran Dry Type Transformers close to the job—thus improve motor performance, obtain load flexibility and eliminate long runs of heavy copper. Small, light, complete with conduit fittings, AmerTran Dry Type Transformers need no vaults . . .

GO PRACTICALLY ANYWHERE

ON WALLS

Easily mounted, most sizes require only two bolts. Conduit fittings make them inexpensive to connect.

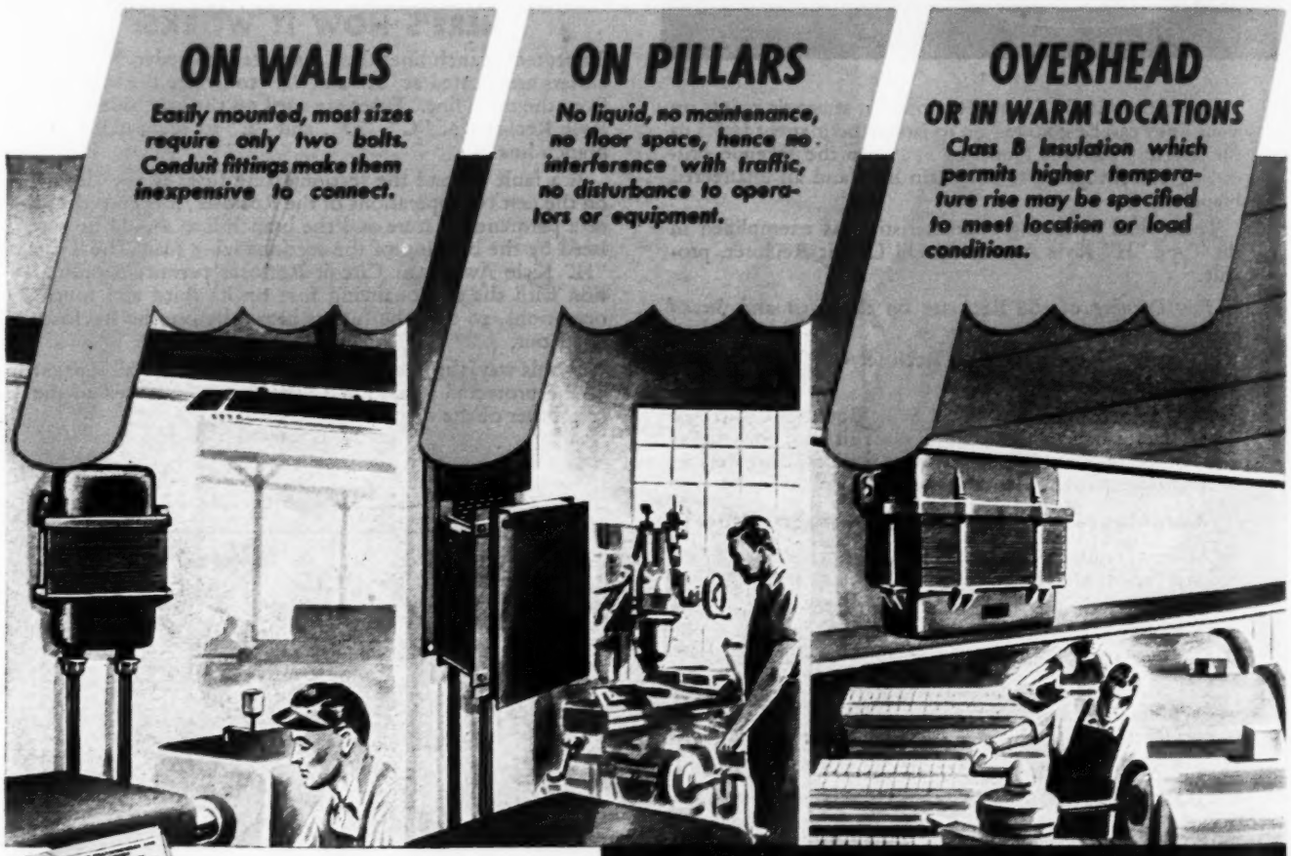
ON PILLARS

No liquid, no maintenance, no floor space, hence no interference with traffic, no disturbance to operators or equipment.

OVERHEAD

OR IN WARM LOCATIONS

Class B insulation which permits higher temperature rise may be specified to meet location or load conditions.



WRITE FOR BULLETIN No. 1116-A which describes AmerTran general purpose dry type transformers, gives construction data, electrical ratings, prices, etc.

THE AMERICAN TRANSFORMER CO., 178 Emmet St., Newark 5, N. J.

AMERTRAN

MANUFACTURING SINCE 1901 AT NEWARK, N. J.

Pioneer Manufacturers of Transformers, Reactors and Rectifiers for Electronics and Power Transmission

AMER-TRAN

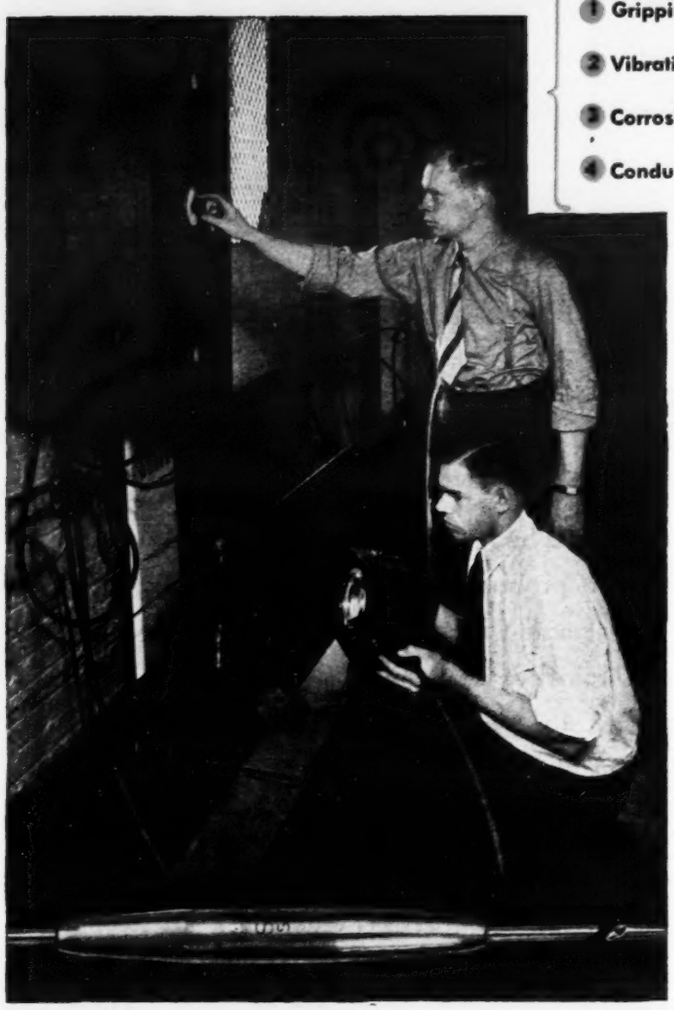
2ND TEST OF A SERIES

Reliable proves that STRAIGHTLINE SPLICES AND DEAD ENDS ARE VIBRATION PROOF

Engineered and built in our own factory, this elaborate vibrating machine reduces years of actual field service to a matter of hours. Accelerated vibration studies on this machine cannot loosen Reliable Connectors, Splices or Deadends. Practically any vibration frequency and load range can be studied with the aid of a strobescope, proving the merits of design details without risking failures in the field.

Seeing is believing—watch for other test proof

1. **Gripping Test**
2. **Vibration Test**
3. **Corrosion Test**
4. **Conductivity Test**

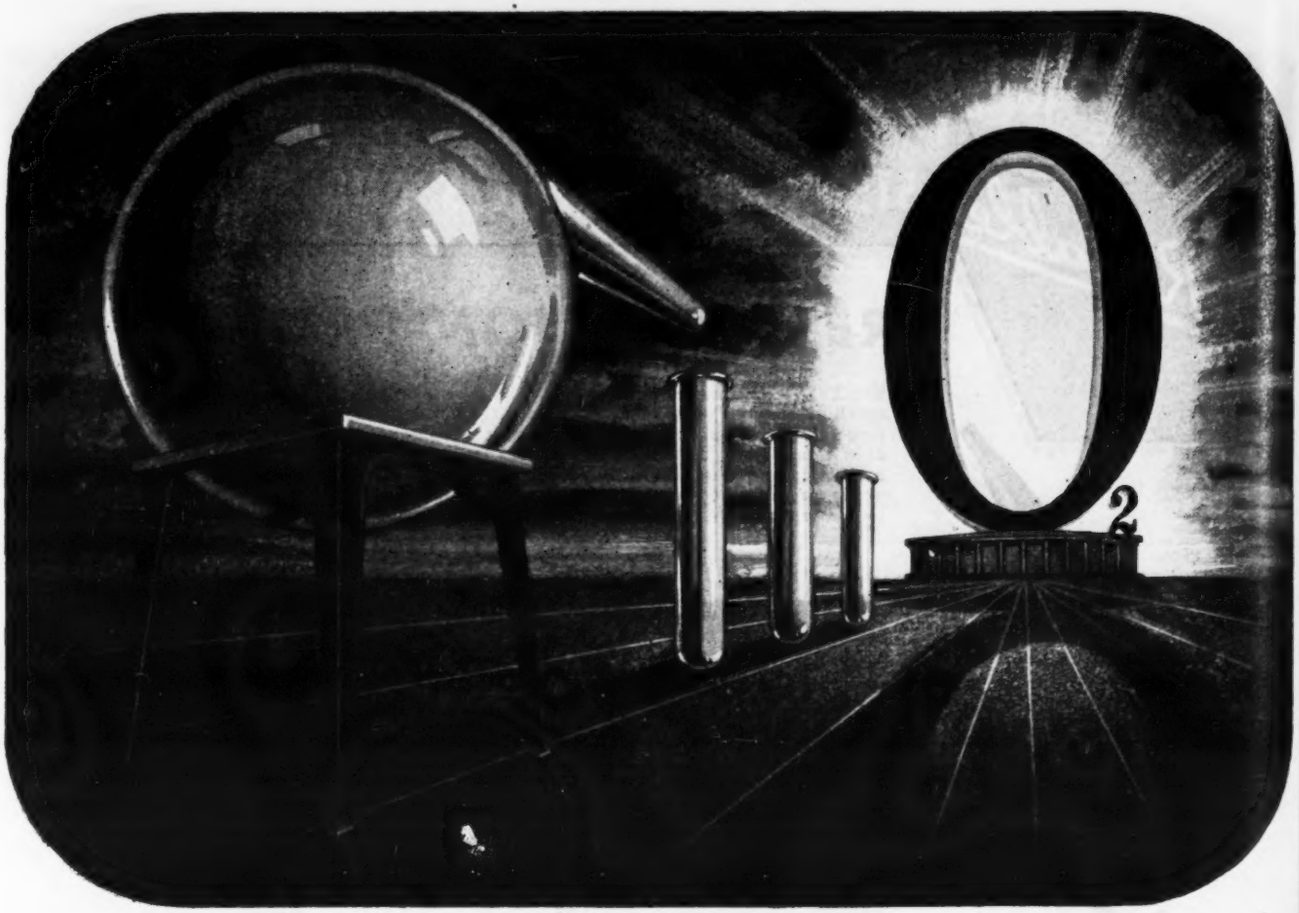


Here is a typical test proving the Reliable Splices and Deadends do not concentrate fatigue strains.

RELIABLE ELECTRIC COMPANY

3145 Carroll Avenue, Chicago 12, Illinois

OVER 35 YEARS SERVICE TO THE UTILITIES



If there were no oxygen . . . ?

. . . or maybe we'd better say—if oxygen didn't cause metal to rust, then electric heating elements would probably last almost forever. At least, it is oxygen that is the chief cause of the ultimate wear-out of the wire. This fact blocked the practical use of electric heat, until Chromel came along almost 40 years ago. (That's a good thing to remember). Chromel staunchly withstood, and still does, the relentless, gnawing oxygen. Chromel is an old faithful, of uniform resistance, good working properties and fine durability. Chromel is usefully described in Catalog-M, which we'll gladly send you.

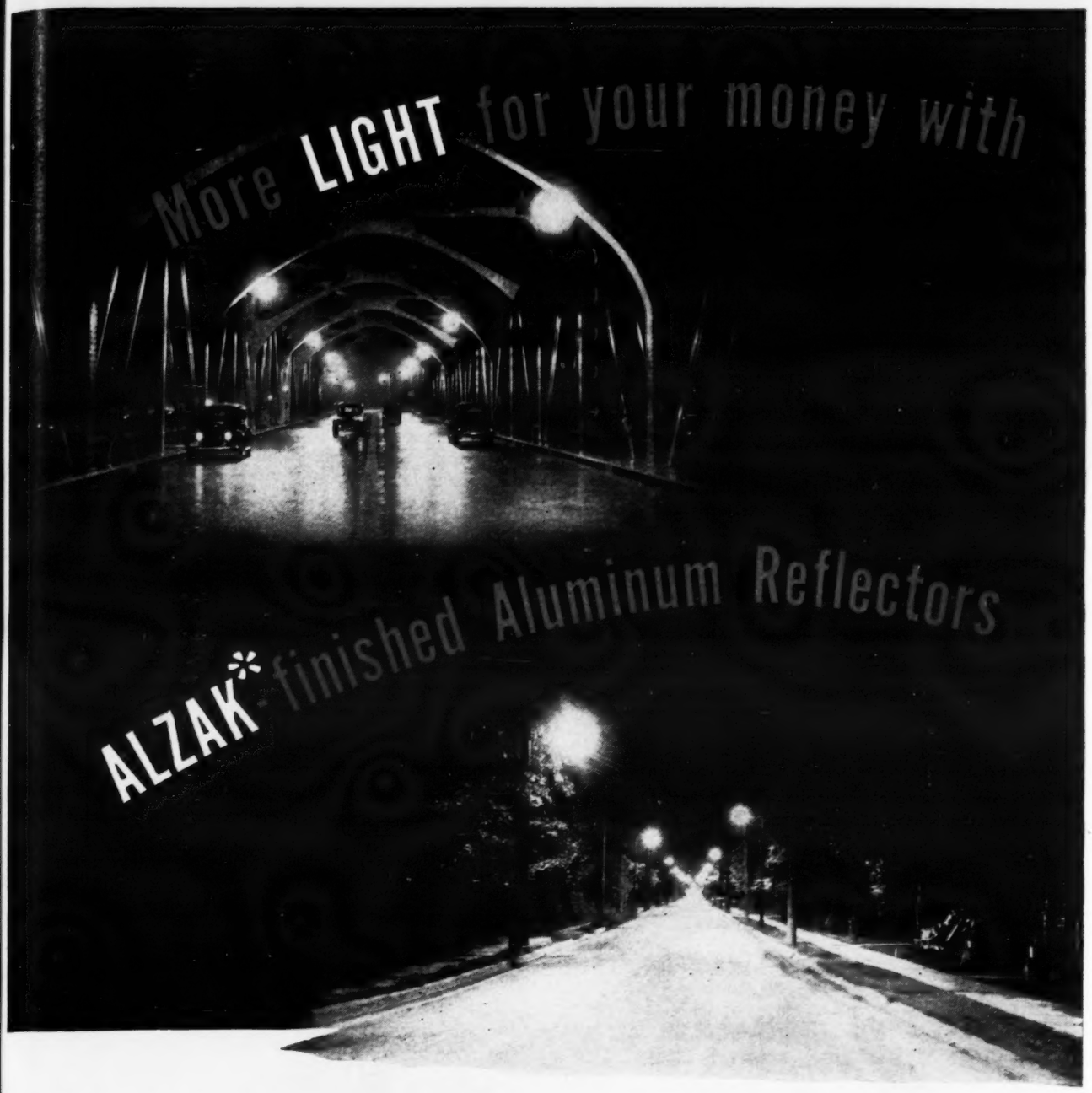
RESISTIVITY @ 68°F

	WIRE (C. M. Ft.)	RIBBON (Sq. M. Ft.
Chromel-A	650 Ohms	510 Ohms
Chromel-C	675 Ohms	530 Ohms
Chromel-D	600 Ohms	471 Ohms
Copel	294 Ohms	231 Ohms

Chromel* NICKEL CHROMIUM
HOSKINS CHROMEL
ELECTRICAL HEATING ELEMENT
WIRE

***Used as the heating element in millions of devices*

HOSKINS MANUFACTURING COMPANY, DETROIT 8, MICHIGAN



Maximum efficiency for your lighting system, long life and low annual costs—you gain these benefits by specifying Alzak-finished Aluminum light reflectors.

The high reflectivity of Alcoa's Alzak-finished lighting sheet, in combination with the reflector manufacturers' designs, accounts for this high efficiency. The ease with which Alzak reflectors can be kept clean enables you to maintain this efficiency throughout the life of the system.

Alzak reflectors come in various finishes; for indoor and outdoor work, for spot illumination and diffuse. In ordering your reflectors, be sure to specify the type of Alzak finish for each job. Your reflector manufacturer can meet those requirements.

ALUMINUM COMPANY OF AMERICA, 2138 Gulf Building, Pittsburgh 19, Pennsylvania.

*Registered trademark

ALCOA FIRST IN ALUMINUM

ALCOA ALUMINUM

WATCHFUL EYES *This ideally arranged Mica Inspection Department is equipped with most modern facilities so that accuracy beyond a doubt is at all times possible. Each inspector is highly trained in this important job of inspection. Mica Capacitors play a vital part in the correct functioning of many types of equipment. Thus, expert inspection must be maintained constantly.*

HOW EXCELLENCE

• Constant vigilance and attention to even the minutest manufacturing detail are part of Sangamo's contribution in designing and manufacturing a complete line of mica capacitors which merit every confidence of the most critical user of capacitors.

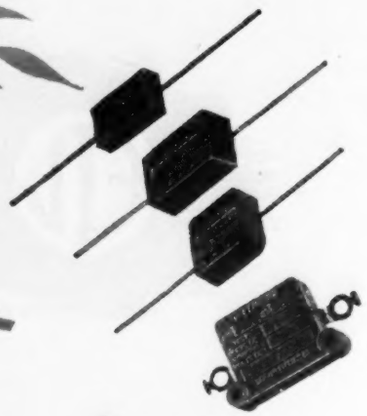
SANGAMO ELECTRIC

ESTABLISHED 1898 • • • MICA CAPACITORS • • •

IS BUILT INTO

Sangamo

MICA CAPACITORS



Mica Inspection

Long trouble-free life of mica capacitors is entirely dependent upon the quality of the mica dielectric used in the capacitor. Careful splitting, precision gauging, accurate sorting, and clean punching of mica sheets, contribute to long trouble-free life of finished capacitors. Every piece of mica must be carefully inspected before it is assembled into a capacitor unit. Such inspection is necessary to assure freedom from all flaws such as fractures, cracks, air bubbles, pinholes, or the inclusion of metallic or other extraneous material.

The slightest fracture at the edge of a mica film will tend to run when the capacitor is moulded and will ultimately result in dielectric breakdown of the entire unit. Ultimate failure of the dielectric may also be expected when air bubbles are present. The inclusion of impurities in mica result in higher losses and, in many cases, in ultimate failure of the capacitor.

The keen eyes of alert, well trained operators are quick to detect the slightest imperfections of the punched mica sheets, so that only mica films free from flaws are passed to be used in the final assembly operations.

★ ★ ARMY E NAVY ★ ★

COMPANY SPRINGFIELD ILLINOIS

• • • WATT HOUR METERS • • • TIME SWITCHES • • •

SINGLE TESTS

This emblem denotes that a single test has been made at ETL and a report has been issued.

The report itself describes the sampling procedure.

CERTIFICATION

The shield marks products which are tested periodically in accordance with industry specifications, and that the sampling is random selection from current factory production or warehouse stocks.

SAFETY STEPS
IN PRODUCT DEVELOPMENT

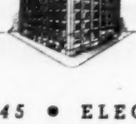
With the enormous backlog of consumer demand — and the race to meet it — with new designs — new materials — new manufacturing techniques — it will be hazardous for any manufacturer to await public reaction for evaluation of his product.

Impartial research and testing are safety steps in manufacturing operations and they can be secured today at reasonable cost, compared to that for the operation of a private laboratory.

The skilled technicians, the specialized apparatus, and the long experience in design and operations tests that are extensively used by both large and small manufacturers are available to anyone who wishes to engage in research and testing for the design and improvement of his product.

Electrical Testing Laboratories, Inc.

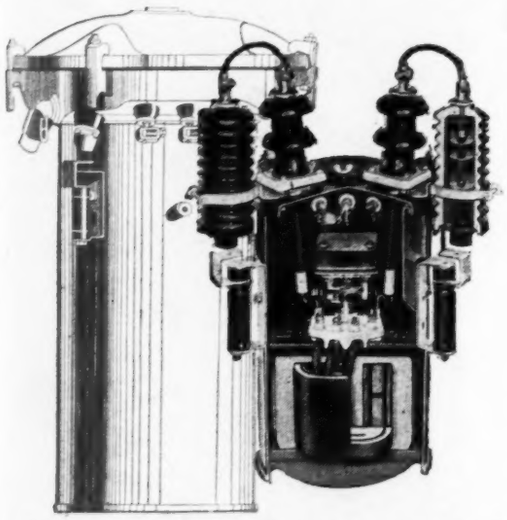
HEADQUARTERS AND LABORATORIES
2 EAST END AVENUE AT 79TH STREET · NEW YORK 21.
BUTTERFIELD 8-2600



ELECTRICAL AND GENERAL TESTING · INSPECTIONS · RESEARCH · CERTIFICATION

Will your distribution transformers be safe when this happens at fifty homes on one circuit? They will be safe if they're CSP distribution transformers!

THEY LET YOUR FUTURE LOAD CHANGES PLAN THEMSELVES



The complete lightning protection feature of CSP transformers protects the insulation between the windings, and between either winding and the tank or core. This is accomplished by limiting the potential difference between any two of these points, chiefly by "De-ion" arresters. It is done so effectively, extinguishing the power-follow arc within a half-cycle, that there is not even any light flicker on consumer feeders.

Why try to predict in fine detail, just where your domestic loads will grow? Or when? Or how much?

If you let CSP distribution transformers handle your load, the load itself will notify you safely . . . economically . . . and in plenty of time. Completely Self-Protecting (against dangerous overloads, short circuits and lightning), these Westinghouse transformers can be matched closely to your present load, eliminating idle capacity.

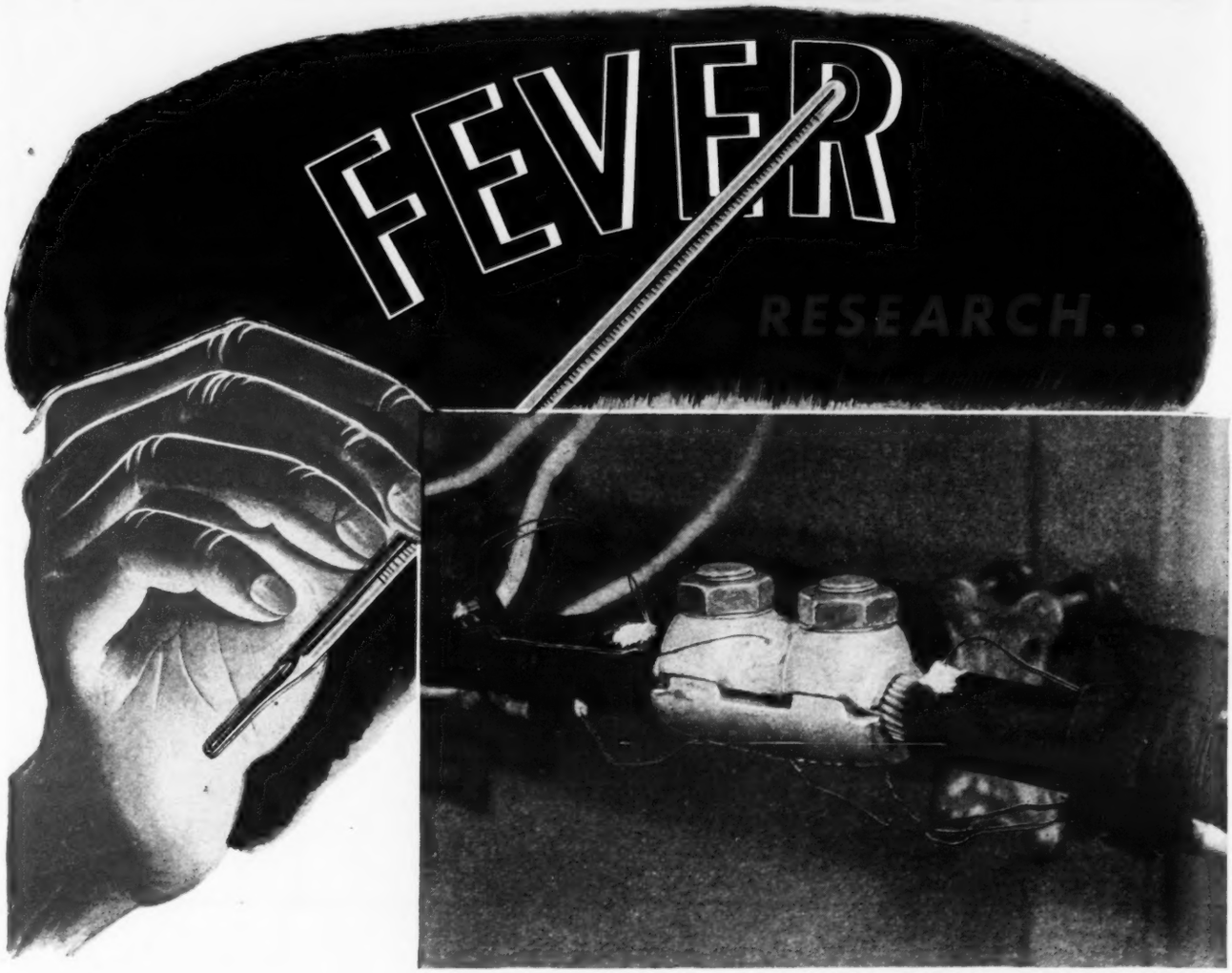
When the load has started to grow, you'll get the warning signal light to tip you off. Or, at the most, the internal breaker will trip. Then, in areas where overload conditions persist, you have but one unit to change—since all the protective apparatus is inside the tank.

For complete information, call your Westinghouse office, or write for Descriptive Data 46-100. Westinghouse Electric & Manufacturing Co., P.O. Box 868, Pittsburgh 30, Pa. J-70439

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

CSP DISTRIBUTION TRANSFORMERS

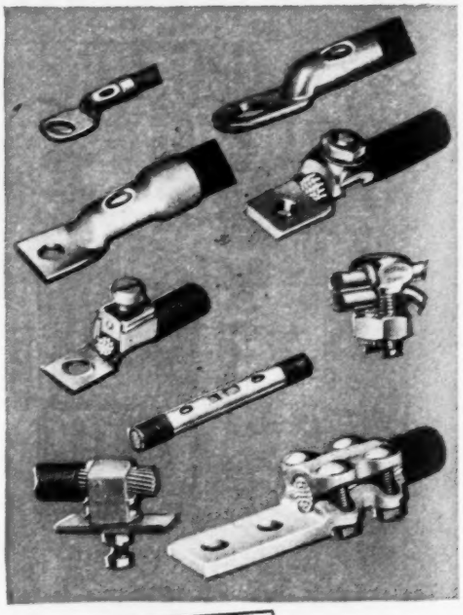


ON *Electrical* CONNECTORS

The temperature-rise test illustrated above is the most important test for determining connector electrical efficiency. For if a connector, under normal load, shows a temperature rise even slightly greater than the conductor, it will become a "hot-spot" in the circuit . . . *a sure source of future* trouble.

Here at Burndy, connector temperatures are recorded at many points by sensitive thermocouples . . . under normal load and under overload as well. If a connector "passes" this critical test you can be sure that its design is proper for adequate heat dissipation; that it has proper contact areas; and is made of the right materials.

This important temperature-rise test is usual practice here in the Burndy laboratory. It's one of a long series of tests which connectors *must* pass before they can bear the Burndy name. Their purpose is to assure that your circuits or equipment suffer no connector troubles in service. Let us send you our latest catalog of Burndy connectors. Burndy Engineering Co., Inc., 107J Bruckner Blvd., New York 54, N. Y.

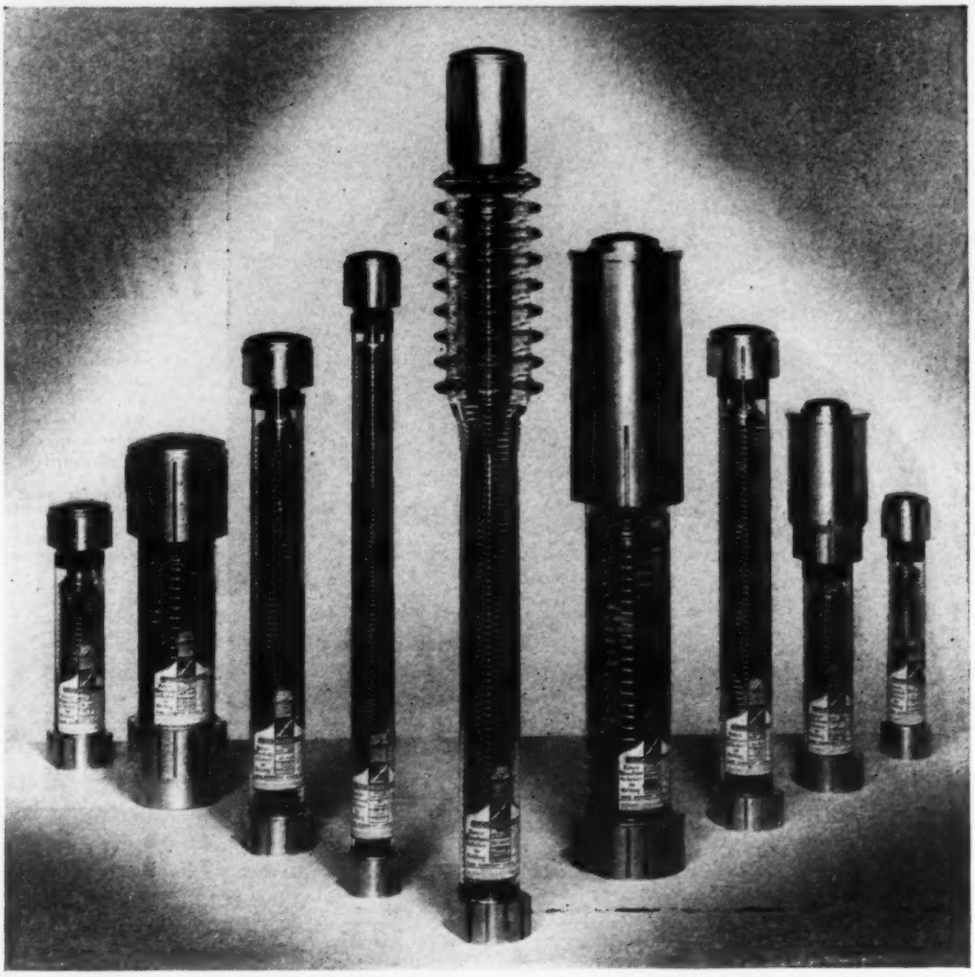


Headquarters for CONNECTORS

Burndy

In Canada: Canadian Line Materials, Limited, Toronto 13

"EXPERIENCE CHOOSES S & C FUSES"



STILL FIRST CHOICE AMONG DISCRIMINATING ENGINEERS

LIQUID FUSES

For protection to power and potential transformers on systems up to 138,000 V* S&C fuses have been the acknowledged standards, world-wide, for nearly a quarter of a century.

*½ to 400 amps. 7,500 to 138,000 volts at 60 cycles

1. Visual indication at all times—blown fuses can be seen from the ground without removing them.
2. Accurate time current characteristics—for coordination with other protective devices—the most accurate fuses made.
3. Long life—fuse elements are made of pure silver—do not corrode or fatigue.
4. Fast clearing time under all values of fault currents up to maximum interrupting capacity.
5. Proven reliable performance throughout years of service.

Continuous improvements over the years have made these fuses today the most accurate and dependable for high current interrupting ratings. Write for Bulletin 200B.

SCHWEITZER & CONRAD, INC.
4421 Ravenswood Avenue, Chicago 40, U. S. A.
Represented in Principal Cities (Consult Telephone Directory)
In Canada by Powerlite Devices, Ltd., Toronto, Ont.

What's Behind

Assembling an insulator is a precision job, demanding the best materials and utmost care and precision. Proper assembly means an insulator in which the hardware and the insulating porcelain become an inseparable physical unit . . . for longer, uninterrupted "Right On The Job" Service.

Write for your copy of the Pinco Catalog showing Pinco Standard Insulators and Hardware.

Pinco Standard Insulators are cataloged in the Electrical Buyers Reference.

38 A special insulator cement is used for permanently fastening the porcelain to the hardware to make the completed insulator. Here is shown a special cement mixing machine developed by Pinco to insure a thorough mixture and the uniformly fine texture which results in a water resistant cement.

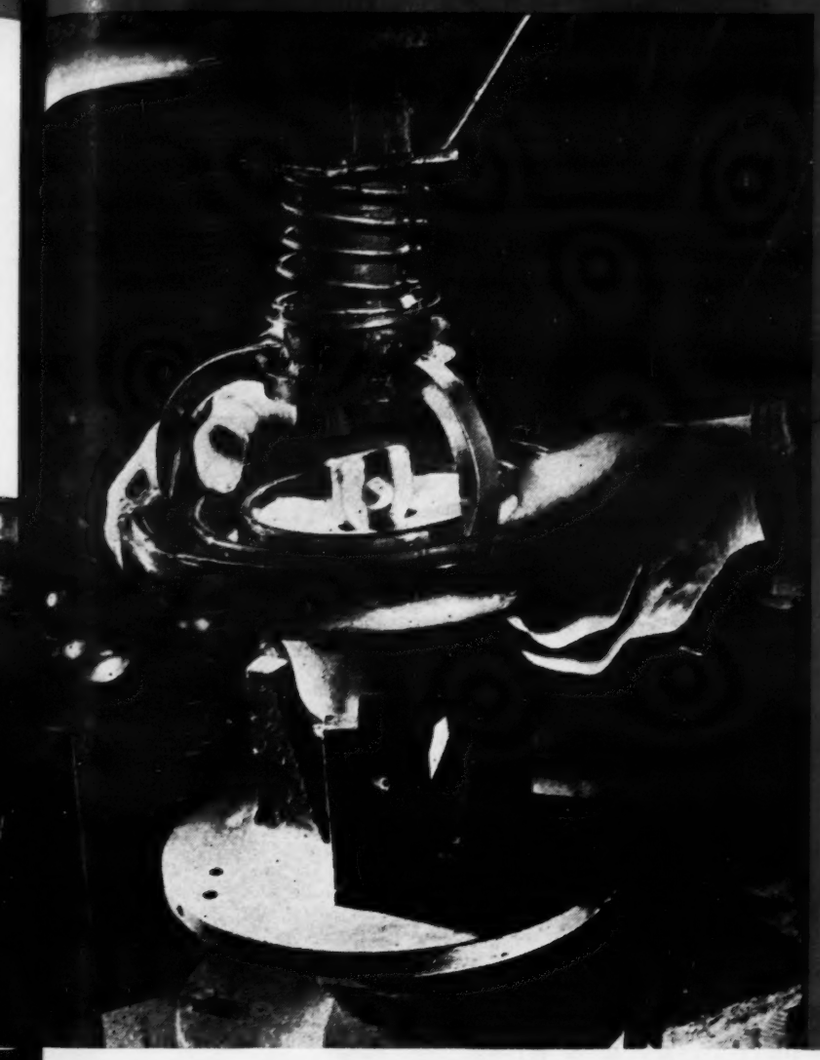
39 A resilient compound specially developed by Pinco is used on all Pinco Insulators to compensate for differences in thermal expansion of metal, porcelain and cement, and to provide uniform distribution of load. Several ingredients are used to insure the necessary flexibility at temperatures as low as −40 F. The Cap of the Pinco No. 1060 Insulator shown in this photo is an original Pinco design contributing to the great strength which is a feature of this insulator.

40 Thermal relief gaskets being placed on the porcelain of the Pinco No. 1510 six inch disc. These gaskets, removed in the cleaning operation, leave the proper spacing between bottom of the cap and top of the porcelain to provide for expansion.

Suspension Insulators . . . . Switch & Bus Insulators . . . . Distribution Pin Types and Guy Strain . . . . One Piece & Multi-part High Voltage Pin Types . . . . Suspension & Strain Clamps . . .

PINCO
INSULATORS

"RIGHT on the Job" Service?



This is the seventh in a series of advertisements showing how Pinco Insulators are made by the wet plastic process in which all forming operations are performed with the clay in plastic state.

41 Because exact clevis alignment is so important in line construction work, Pinco developed the assembly jig shown here. Clevis type cap, porcelain and pin are accurately centered and tongue of the eyebolt lined up with the ears of the clevis cap to provide free swinging strings and to keep them from binding or cramping in service.

PINCO No. 1070

The Porcelain Insulator Corporation

658 Main Street, Lima, New York

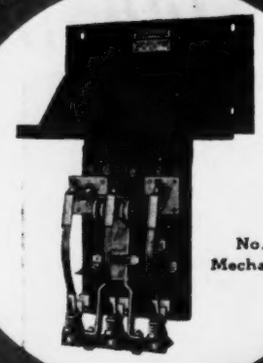
SALES AGENTS—JOSLYN MFG. & SUPPLY CO., Chicago 6, Ill.; Kansas City 16, Mo.; Monticello 2, Ind.; Omaha 4, Neb.; Springfield, Ill.; The Joslyn Company, New York 5, N. Y.; Baltimore 25, Md.; Philadelphia 2, Pa.; Richmond 21, Va.; Rochester 10, N. Y.; Washington 8, D. C.; South East Joslyn Co., Cincinnati 7, Ohio; Atlanta 3, Ga.; Cleveland 13, Ohio; Jacksonville, Fla.; Lexington, Ky; Jobbers Supply Company, St. Paul 4, Minn., Portland 9, Ore.; Seattle 4, Wash.; Southern Joslyn Co., New Orleans 19, La.; Joslyn Southwest Co., Dallas 1, Tex.; Houston 4, Tex.; Joslyn Co. of California, Los Angeles 11, Calif.; San Francisco 3, Calif.; H. E. Burns, Pittsburg, Pa.; Paul A. Douden Co., Denver 2, Colo.; Paul Carson, Amarillo, Tex.; J. J. Costello, Boston 16, Mass.

Distribution Clamps . . . . Transmission Line Fittings . . . . Transformer & Circuit Breaker Bushings . . . . Indoor Bus Support Porcelain . . . . Tree Insulators . . . . Lightning Arrester Porcelain

E&M

PUSH BUTTON

No. 1
ZEO



No. 2
Mechanism

No. 2
ZEO

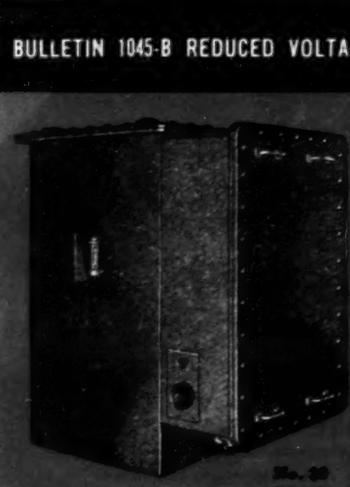
BULLETIN 1065-A FULL VOLTAGE OIL-BREAK STARTERS FOR 110-550 VOLT MOTORS

No. 1, 2 or 3
ZEC

No. 1
Compensator-
Mechanism

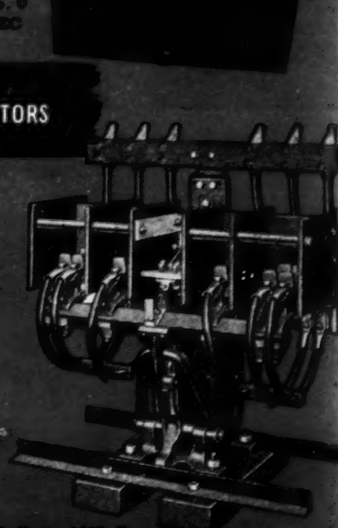
No. 0
ZEC

BULLETIN 1045-B REDUCED VOLTAGE OIL-IMMERSED STARTERS FOR 110-550 VOLT MOTORS



No. 00
ZEEC

Bulletin 1047-C Compensator-



Bulletin 1032-C
Contactor for 2300 Volt Motors

STARTERS

FOR CLASS 1 GROUP D HAZARDOUS LOCATIONS

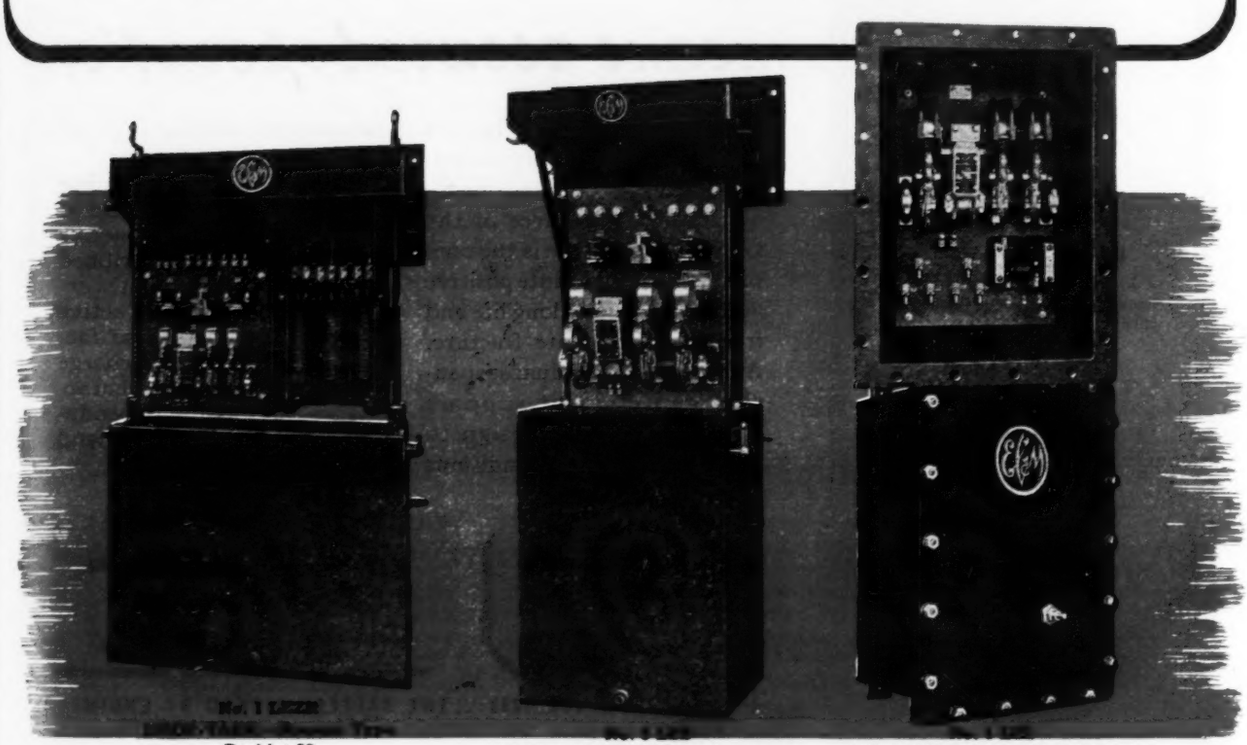
TYPE EO PUSH BUTTON BULLETIN 1105-C
Tested and Listed by the Underwriters' Laboratories for Class 1, Group D Hazardous Locations.

WE make a specialty of building motor control equipment for operation in oil refineries, gasoline plants, paint and lacquer plants, and similar Class 1, Group D Hazardous Locations where highly inflammable volatile substances are manufactured, handled or used.

Pictured on these pages are several forms of EC&M starters for the successful operation of both low and high voltage squirrel-cage motors. Each starter-mechanism is of substantial construction for long periods of operation without attention. Completely enclosed, only an occasional "opening up" for inspection is required.

The Type EO Push Button is without equal for remote control of starters in explosive atmospheres and is also used by many plants for turning lighting circuits on and off in dangerous areas. It is compact, has heavy contacts of simple construction and can be used with or without oil.

Our nearby office will be glad to supply complete information. Specify by individual bulletin numbers or, for a complete set, ask for "Class 1, Group D Literature."



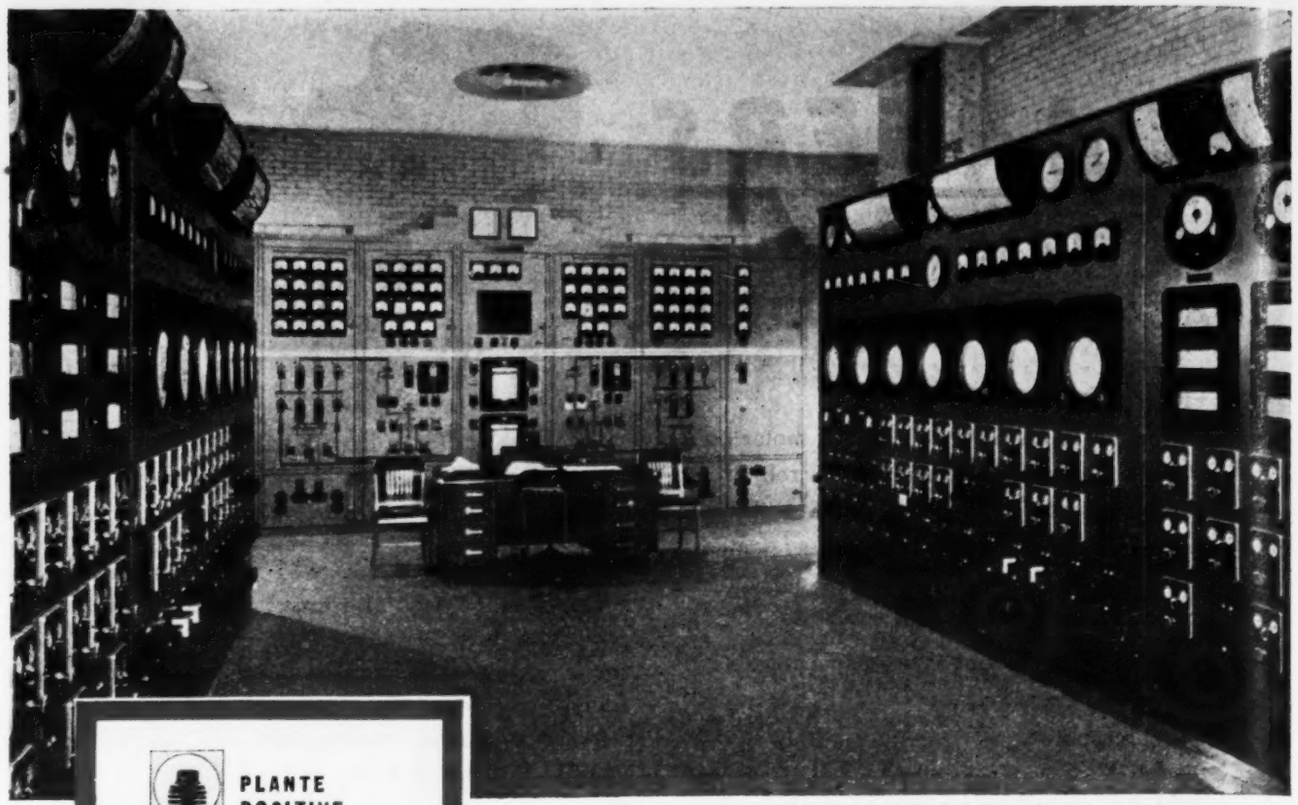
Booklet 88

DROP-TANK—Full Voltage Type
Booklet 88

AIR-BREAK—Full Voltage Type
Bulletin 1067-A

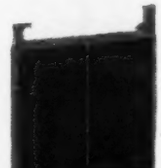
THE ELECTRIC CONTROLLER & MFG. CO.

2698 EAST 79TH STREET — CLEVELAND 4, OHIO



PLANTE POSITIVE

Detail of Plante positive plate ribbed design, with its coating of active material.



DUAL SUSPENSION

A Plante plate with characteristic hooked projection providing exclusive dual suspension.

Write Dept. 123 for Catalog 1000 on Gould Sealed-in-Glass Batteries for Stationary Applications.

GOULD PLANTÉ

means assured operation

Gould research and Gould's half century of battery experience have developed many outstanding features in the Gould Plante. One is the one-piece, pure lead Plante positive with its unusually long life and freedom from plate fracture. Another is Gould dual suspension and element support which provides a design to meet all operating conditions encountered, without internal cell strains.

The Gould Plante battery has the inherent characteristic of converting pure lead to active material as needed. The ribbed design of its positive plates exposes an unusually large active surface. Together these factors permit a high discharge rate with flat voltage characteristics, and assure dependable operation in standby and control services.

GOULD

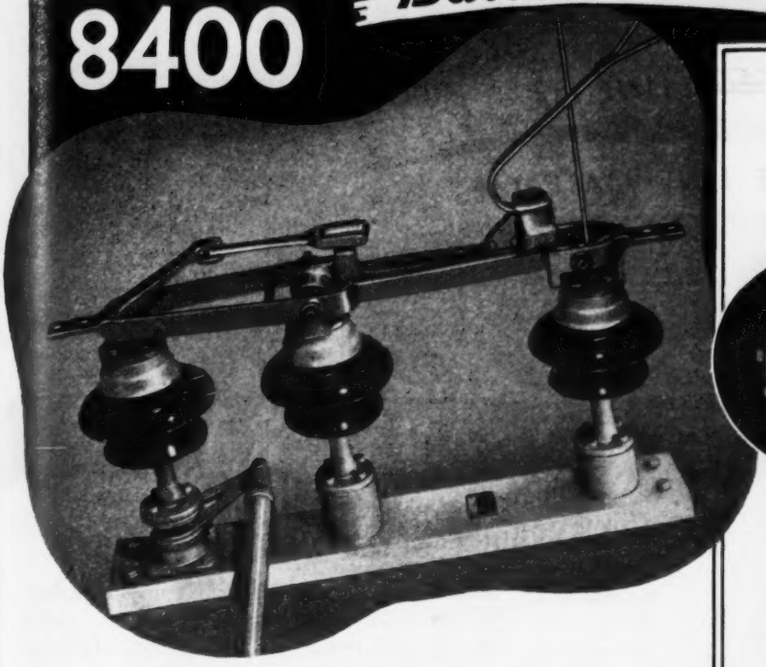
SINCE 1898...THE BATTERY PICKED BY ENGINEERS

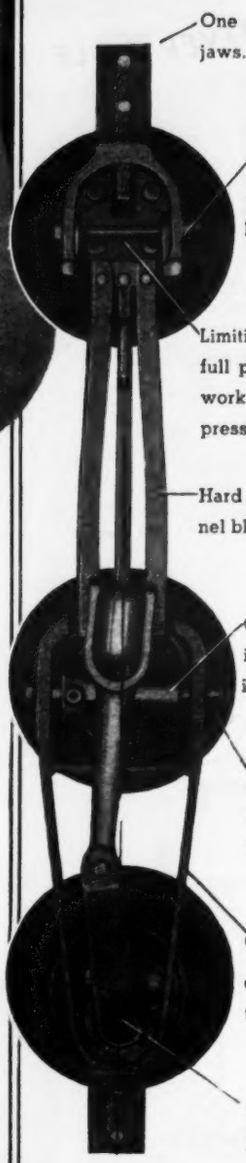
FOR EXCELLENCE IN STORAGE BATTERY PRODUCTION AT DEPEW PLANT

GOULD STORAGE BATTERY CORPORATION, Depew, New York. Factories: Atlanta • Chicago • Dallas • Depew • Leavenworth • Los Angeles • North Bergen • Rockford • St. Paul • Sioux City • Zanesville

"Three E"

8400 Balanced High Pressure




One piece terminal pad and contact jaws.
Adjustable front contact spring establishes predetermined high pressures.
Limiting sleeve holds jaws at 90% of full pressure — eliminates 90% of work and wear in re-establishing full pressure.
Hard drawn electrolytic copper channel blades.
Combination hinge contact limiting sleeve and counterbalancing spring holder and hood.
Adjustable hinge contact spring establishes predetermined high pressures.
One piece terminal pad, current carrying bridge and hinge contacts.
Locking toggle joint shown in locked, over-center position.

Simplicity and Efficiency

8400 Balanced High Pressure is obtained by new applications of old, established, time-tried engineering principles. Balance is achieved by carefully counterbalancing parts and forces so that all unnecessary twists and strains are removed. A large percentage of the work required to operate the switch and establish full pressure is eliminated by the ingenious Limiting Sleeve.

Counterbalanced push-pull blades wipe contact surfaces clean at every operation. The locking toggle joint establishes pressure when nearly at dead center thus making pressure application almost effortless. Over-center position of the toggle positively locks blades into full pressure position.

The switch structure is remarkably simple and employs a minimum number of parts. Yet, its mechanical and electrical performance represents the maximum in high pressure efficiency and current carrying ability.

All adjustments are made at the factory before shipment. Installation can be made quickly with a minimum of labor. "8400" switch service is outstanding in dependability and freedom from maintenance requirements.

Write for your copy of Bulletin 327

The 8400 High Pressure switch has been employed in many of the nation's most important and largest installations. Performance records prove it to be outstanding in dependability and unusually easy to operate regardless of atmospheric conditions. Standard units are available in ratings of 400, 600 and 1200 amperes at voltages from 7500 to 287000. Other sizes can be furnished.

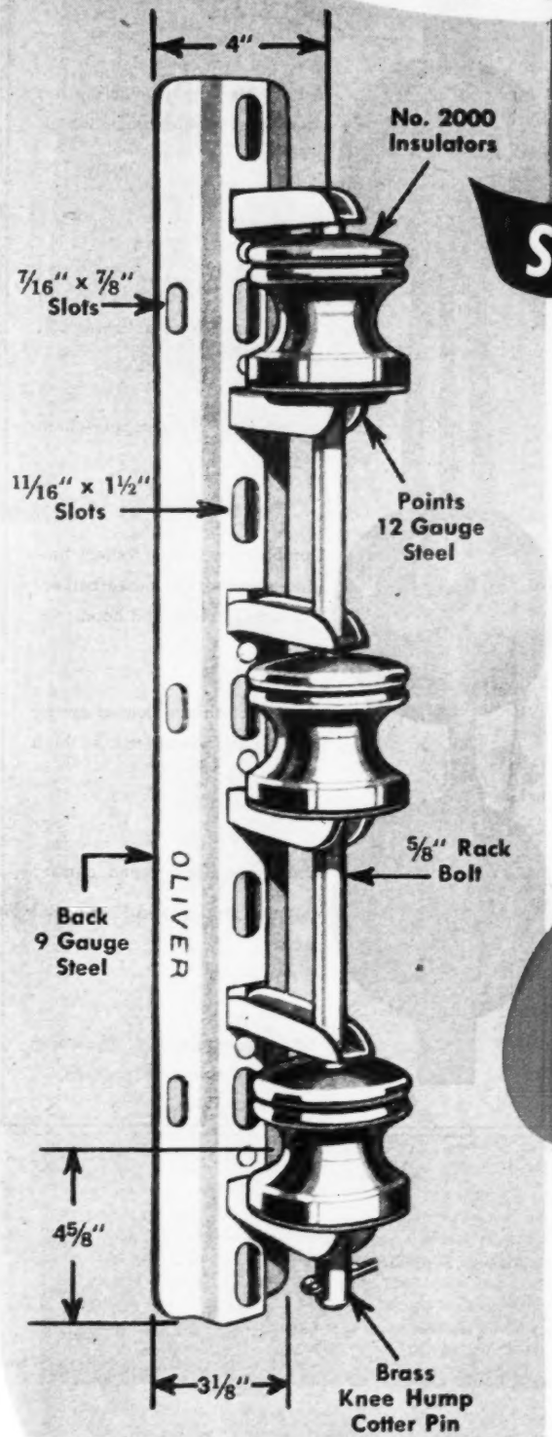
THREE E

ELECTRICAL ENGINEERS EQUIPMENT CO.
MELROSE PARK ILLINOIS

FROM THE *Complete* LINE OF

OLIVER POLE LINE MATERIALS . . .

Oliver SECONDARY RACKS

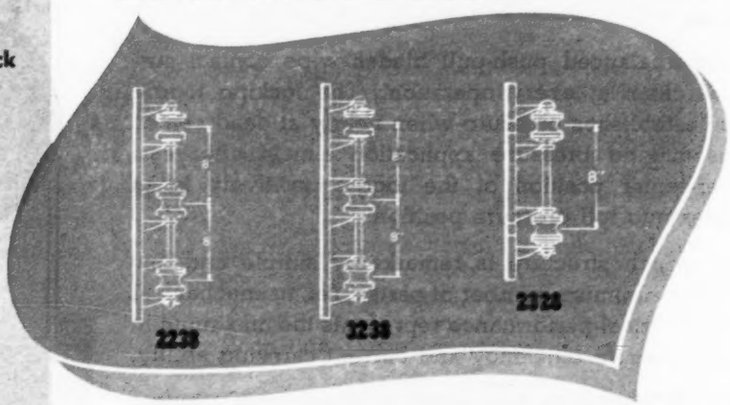


U-THROUGH STYLE IS STRONG, RIGID

A relatively new type of construction for Secondary Racks, the Oliver U-Through Style combines extra strength and rigidity with the other advantages of Oliver designs. Points are pressed in a U shape and firmly riveted in place through the panel, making a strong, dependable construction. All corners are well rounded to prevent injury to the line. The Oliver Hot Dip Galvanizing process insures adequate protection.

STYLES FOR ALL TYPES OF SERVICE

Oliver U-Through Secondary Racks are made in light and heavy types, with extended or non-extended back, in sizes to meet all usual conditions.



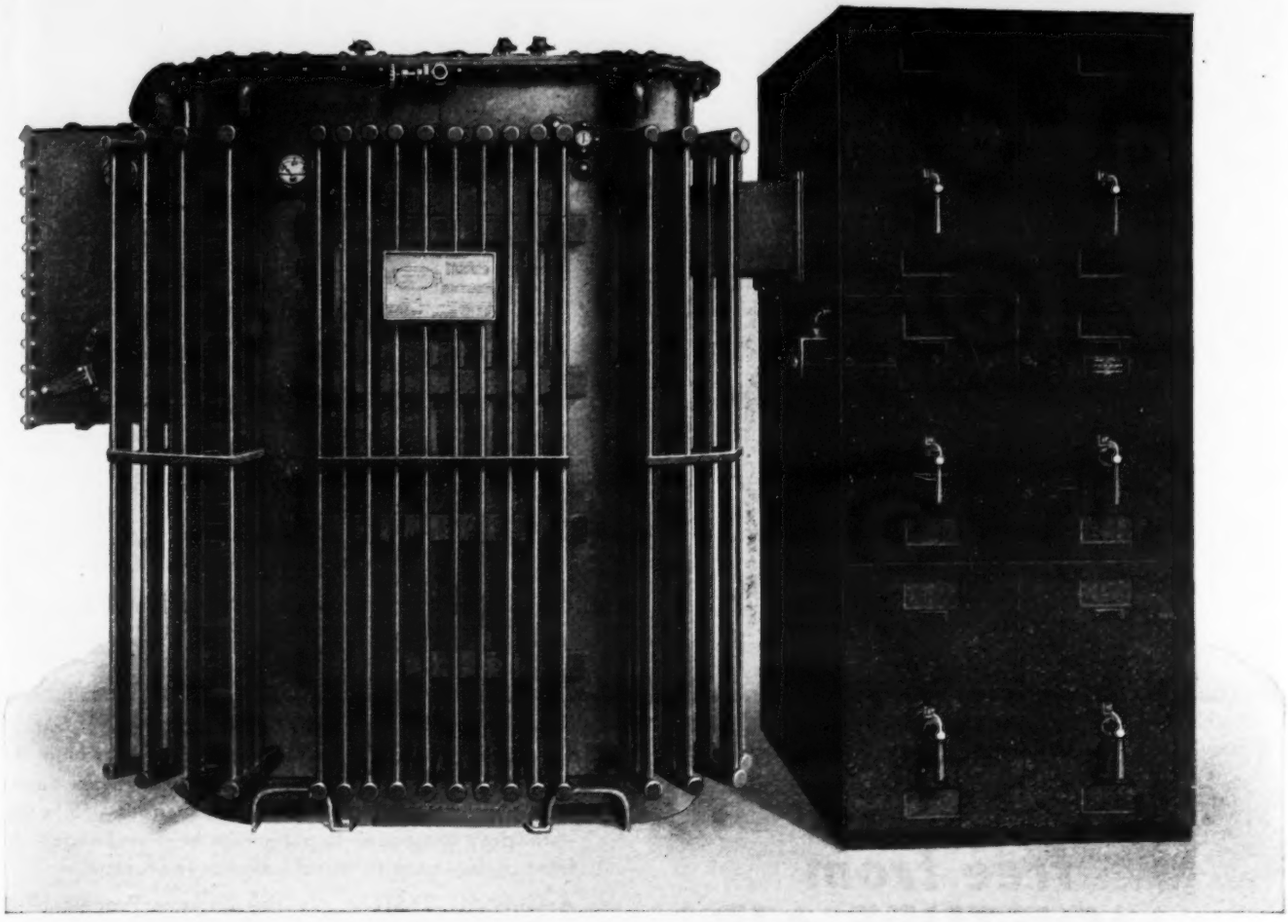
Our nearest representative will gladly give you full details about these and other Oliver Secondary Racks, as well as additional items of Oliver Pole Line Materials.

OLIVER IRON AND STEEL CORPORATION

SOUTH TENTH AND MURIEL STREETS · PITTSBURGH 3, PA.

MOLONEY

UNIT SUBSTATIONS
WITH ASKAREL, AIR, OR OIL-COOLED
TRANSFORMERS



MOLONEY Load Center Type UNIT SUBSTATIONS

ILLUSTRATED is a 1000 Kva Moloney Unit Substation used in an industrial plant for load center power distribution. Transformer is Askarel-cooled permitting installation indoors without the expense of a fireproof vault. Locating substation at center of load eliminates long runs of expensive secondary copper. Better regulation increases voltage at points of use, improving performance of equipment served. Unit construction incorporating primary switch, transformer and secondary air circuit breakers simplifies installation and operation.

Load Center type Unit Substations such as this are available with Air-cooled or Askarel-cooled transformers for indoor installation, and Oil-cooled or Askarel-cooled transformers with weatherproof switchgear construction for outdoor use. Unit Substations can be supplied with primary air circuit breakers, selector switches, load break switches, power fuses, metering equipment, or any other desired features.

MOLONEY ELECTRIC COMPANY • ST. LOUIS, U. S. A.

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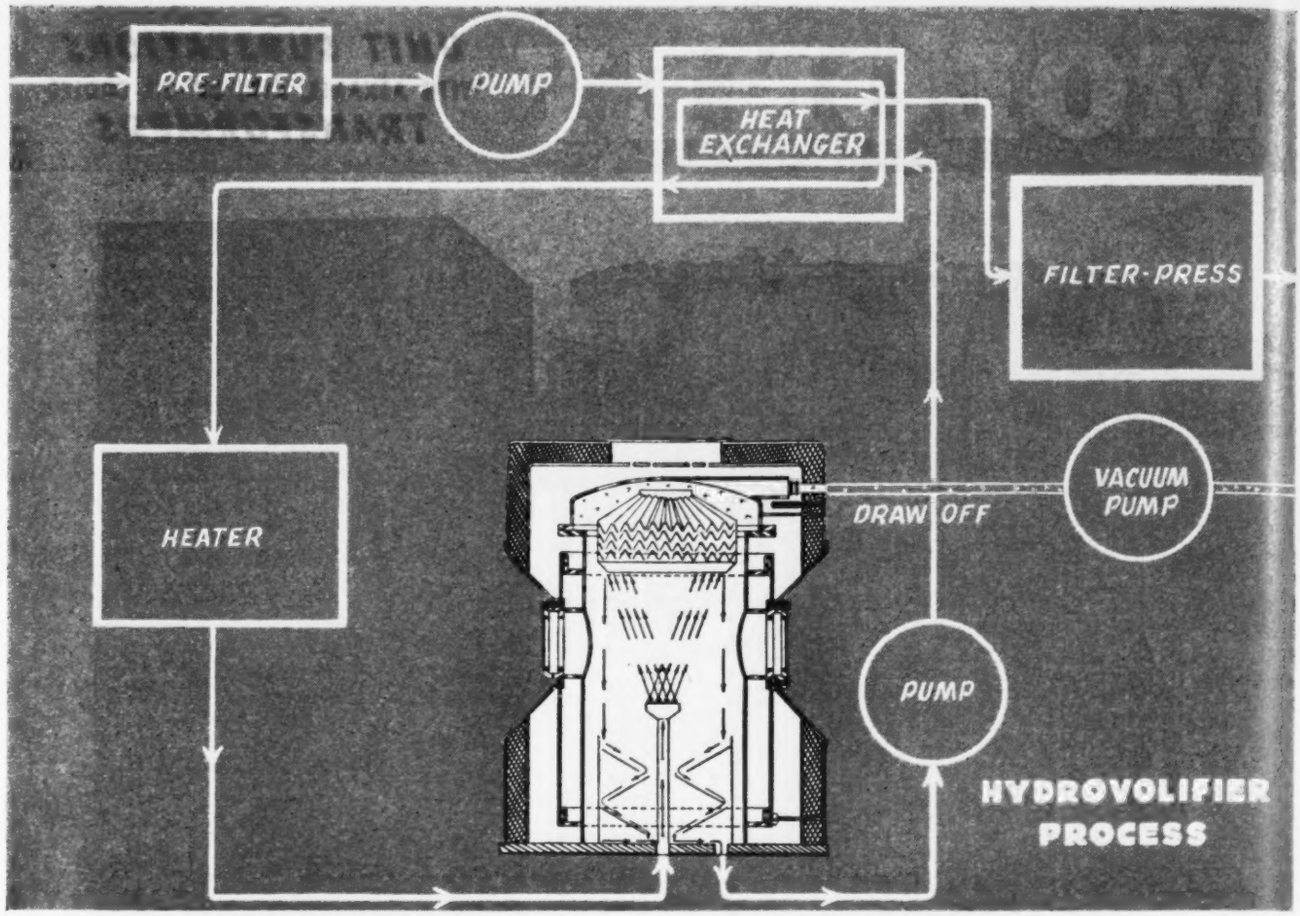
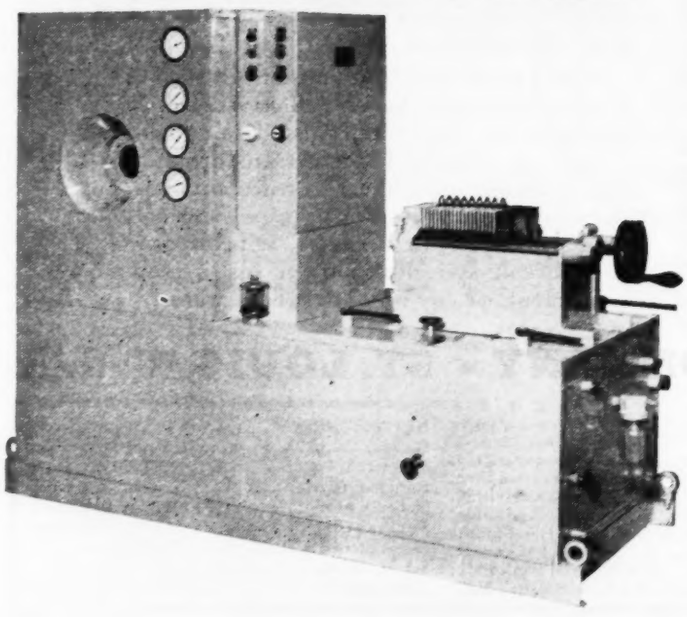


To Keep INSULATING OIL *free from* MOISTURE-AIR *and harmful* ACIDS



OIL IS SERVICED IN A SINGLE PASS through the apparatus. Following the flow chart above, oil passes from pump to pre-filter—to heat exchanger—to heater—to spray chamber—to pump—to heat exchanger—to filter press—back to transformer or to storage.

A CLOSED SYSTEM. In the Buckeye Process oil is treated at low temperature under high vacuum. No air comes in contact with oil during processing.

A PORTABLE, COMPACT MACHINE Permits servicing of transformers in place without service interruptions.

SIMPLE, AUTOMATIC OPERATION. Only three connections are made—the inlet and outlet lines and power circuit. Temperatures and pressures are automatically controlled.

CONTINUOUS PROCESS. Oil from transformer flows through Hydrovolifier is returned to transformer in a continuous circuit.

LARGE CAPACITY. Three standard sizes—100 gal. per hr.—300 gal. per hr.—500 gal. per hr.

Write for Hydrovolifier bulletin.

BUCKEYE
LABORATORIES CORPORATION

1965 E. 66th St.
CLEVELAND 3, OHIO

5½ OUT OF 8

major design developments in electrical porcelain have been made by Westinghouse

FARADOID PRINCIPLE improved performance of high-voltage transmission lines. Surfaces were proportioned to conform to the equipotential surfaces of the electrostatic field. Now an industry-wide standard.

HIGH-STRENGTH SUSPENSION developed to meet demands of railroad electrification. Increased load limits of suspension insulators to 25,000 and 36,000 pounds. Made possible more improvements in power transmission.

RADIO-INTERFERENCE-PROOF (RIP) INSULATORS, first introduced in 1930. Solved the radio reception problem caused by the usual arcing flow of capacity currents between conductor and insulator surfaces. Now an industry standard.

SOLDER SEALING is to this day the only effective means of producing a hermetic joint between metal and porcelain. Gives permanent protection to oil or air-insulated equipment against moisture or dirt.

BULLET-PROOF INSULATORS increased section thickness, and proportioned surfaces so as to always produce ricochet. Helped solve breakage due to stone throwing and target shooting.

PRESTITE is a revolutionary new porcelain, dense, nonporous with high dielectric and mechanical strength. Can be formed to intricate shapes with close tolerances.

LINE AND STATION POST INSULATORS...a co-development of Westinghouse and other engineers.

In the past quarter century, there have been 8 major porcelain improvements. Six of these have been exclusive Westinghouse developments . . . the seventh was a co-development.

For buyers of porcelain, this is a convincing guarantee that they can count on Westinghouse Insulators for leadership in design, research and manufacture.

The co-ordinated engineering which made possible these advances, is now at work on new projects. Feel free to co-ordinate these research facilities with your own porcelain problems and planning . . . and for porcelain backed by the BEST in *electrical* engineering.

Westinghouse maintains 120 stocking points to assure delivery anywhere in the United States. Westinghouse Electric & Manufacturing Company, P. O. Box 868, Pittsburgh 30, Pa. J-05154

Westinghouse

PLANTS IN 25 CITIES... OFFICES EVERYWHERE

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DC
993 VARNISH

Essential to High Temperature Silicone Insulation

Rapidly growing demands for DC-993 Silicone Varnish are being filled from stocks of the above newly-appointed distributors.

Through these representative sources of supply, Dow Corning, first producer of Silicones, is able to extend the application of this revolutionary insulating material—a heat curing, high temperature stable, moisture-proof silicone varnish destined for an important place in the new age of electrical machinery and equipment.

DOW CORNING CORPORATION
BOX 592, MIDLAND, MICHIGAN

JUST OFF THE PRESS—This new eight-page book on DC-993 Silicone Varnish is now available from any of the distributors listed above. Write for a copy. It will give you comprehensive technical information on this new insulating material and its applications.

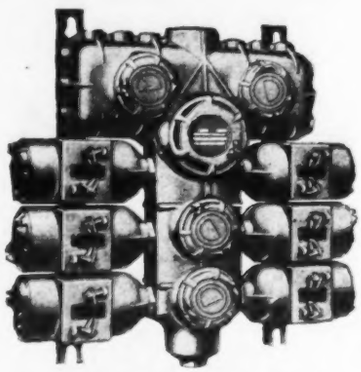
Dow Corning
FIRST IN SILICONES

CROUSE-HINDS

Improved
Type EDP Explosion-Proof Panelboards
Complete with Circuit Breakers

Explosion-Proof, Dust-Tight, Vaportight, and Weatherproof

For hazardous locations where ordinary electrical equipment is unsafe because of the presence of explosive atmosphere or dust. Also suitable where exposed to other dust, vapors or the weather.



Type EDP Panelboard-Size 1

Compact, simplified design. Threaded flame-tight covers and joints. Trip free circuit breakers with padlocking lugs on external handles.

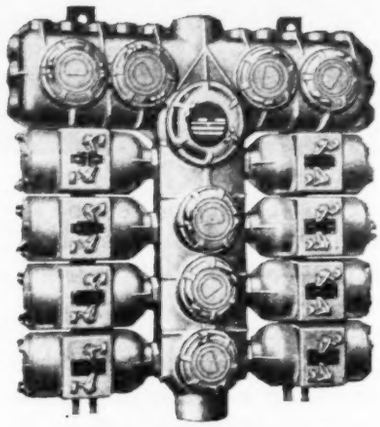
Easily installed and inspected. Extra large cover opening for access to terminals. 3-inch through feed main hubs; 1 or 2-inch branch hubs.

Sealed. Each circuit breaker is sealed from the main wiring chamber. External seals are unnecessary in the conduits.

Solderless (pressure type) terminals for all field wiring.

Main terminals for 2 or 3-wire single-phase; 3 or 4-wire three-phase.

Branches furnished with 1, 2 or 3-pole breakers; with or without solid neutral. Circuit breakers 15 to 50 amperes.



Type EDP Panelboard-Size 2

Write for additional information to

You can buy them through a Crouse-Hinds wholesaler near you.

A Nationwide Distribution Through Electrical Wholesalers

CROUSE-HINDS COMPANY
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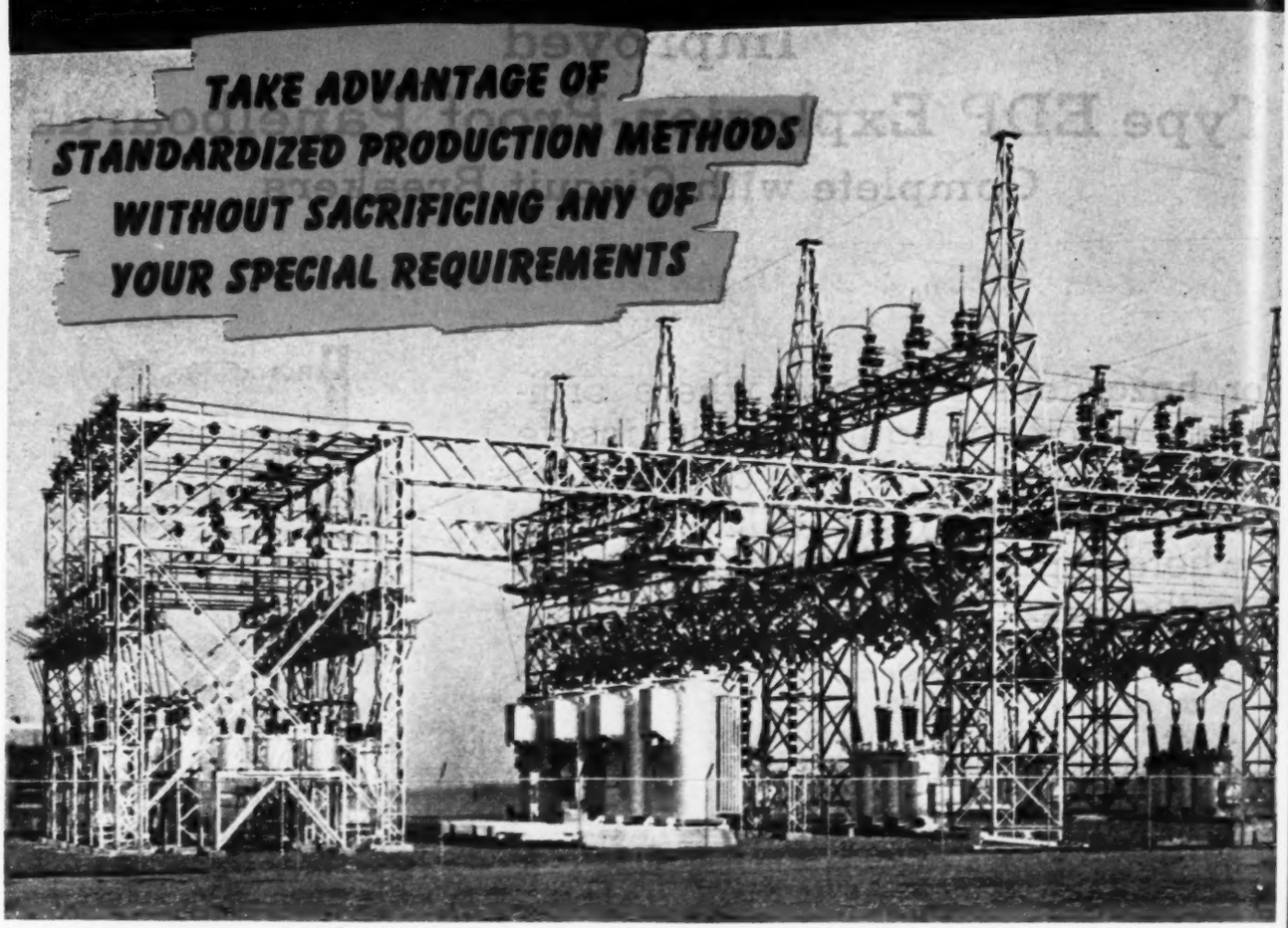
CONDULETS · TRAFFIC SIGNALS · AIRPORT LIGHTING · FLOODLIGHTS

REDUCE SUBSTATION COSTS - SAVE TIME

TAKE ADVANTAGE OF STANDARDIZED PRODUCTION METHODS WITHOUT SACRIFICING ANY OF YOUR SPECIAL REQUIREMENTS



Use Delta-Star specialized service — the result of thirty-five years' experience in the design and fabrication of complete outdoor substations.

HOW?

No, we haven't found a method by which special stations can be completely manufactured and placed on the shelf awaiting your order; but we have evolved production methods for turning out "Tailored" stations quickly and economically. The Delta-Star system of handling minimizes the time required for layout work and detailing. Fabrication and galvanizing of steel structures is under full control in our own shops. Component parts for equipment are in stock ready for assembly. Complete construction drawings are furnished — making erection as easy as assembling a mechanical toy.

For any voltage rating or any type of station just send us a diagram of the proposed installation and such pertinent information as ground space available, arrangement and height of circuits — we do the rest. You then devote your time to other problems — we will recommend the most economical type of station consistent with service requirements and location.

If you haven't already purchased Delta-Star "Tailored" substations, we suggest trying our service on your next installation. *We are sure you will be pleased with the results.*

BUY MORE WAR BONDS - KEEP THOSE YOU HAVE

DELTA-STAR ELECTRIC COMPANY

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CANADIAN ASSOCIATE
Canadian Line Materials Limited — Toronto 13, Canada

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WHAT A DIFFERENCE!

"Compare the bulk," says Romey

Yes, you'll find there's a lot of difference between Rome Synthinol and old-type building wire.

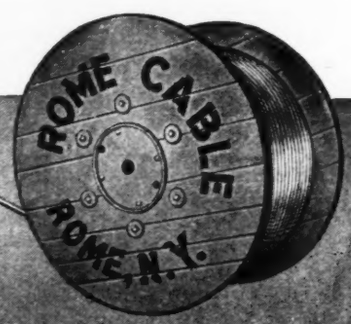
This synthetic resin-covered wire is smaller in diameter, lighter in weight; it's easier to pull, freer stripping; and it's acid, alkali, moisture and oil-resistant.

Rome Synthinol saves time on the job because it's a "fast worker." Eight distinctive colors are stocked.

FROM BAR TO FINISHED WIRE

ROME CABLE CORPORATION

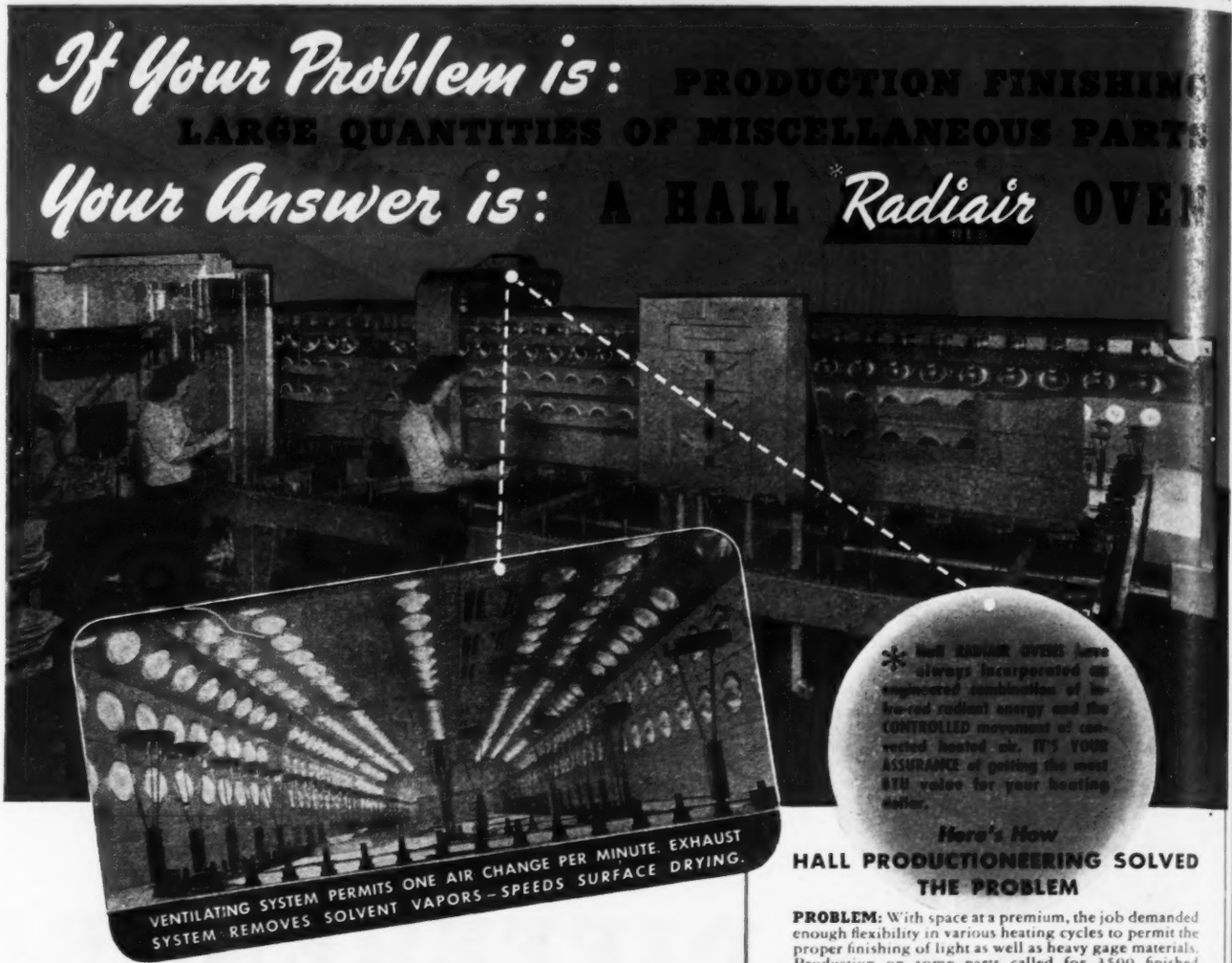
ROME • NEW YORK



ANOTHER C. M. HALL *PRODUCTIONEERED* RADIAIR OVEN APPLICATION

If Your Problem is: PRODUCTION FINISHING LARGE QUANTITIES OF MISCELLANEOUS PARTS

Your Answer is: A HALL *Radiair* OVEN



VENTILATING SYSTEM PERMITS ONE AIR CHANGE PER MINUTE. EXHAUST SYSTEM REMOVES SOLVENT VAPORS—SPEEDS SURFACE DRYING.

* Hall RADIAIR OVENS have always incorporated an engineered combination of infra-red radiant energy and the CONTROLLED movement of convected heated air. IT'S YOUR ASSURANCE of getting the most BTU value for your heating dollar.

BECAUSE heating, drying and baking are vitally important in the production finishing of most war materiel—it is not surprising that infra-red with its numerous advantages has received industrywide acceptance and approval.

Yet, infra-red is not a cure-all. Like any other production process, it has its limitations. *Maximum time-and-money-saving advantages can only be obtained by its correct use in every application.* Because Hall RADIAIR Ovens are engineered on this basic principle the User invariably benefits through new and shorter heating cycles—improved methods of material handling—greater operating flexibility. The end point is always higher production at less cost.

For example, not long ago a war producer was faced with the job of drying and baking large quantities of miscellaneous parts ranging from plastic, rubber-coated rocket rings, to "windshields" for 105 mm and 75 mm shells. It was thought at first that a simple automatic spray operation, plus a run through any low temperature oven would answer the problem. But, there was a catch! The entire operation has to be handled in a space not much larger than an average good sized living room, with provisions made for a 3500 piece per hour capacity.

These requirements made the problem one for the book. Read to the right just how a Hall *Productioneered* application of infra-red solved the problem. Then remember to CALL IN HALL on your next drying, baking, preheating or dehydrating problem. You will not be obligated.

Here's How

HALL PRODUCTIONEERING SOLVED THE PROBLEM

PROBLEM: With space at a premium, the job demanded enough flexibility in various heating cycles to permit the proper finishing of light as well as heavy gage materials. Production on some parts called for 3500 finished pieces per hour.

ANSWER: The automatic spraying operation was made an in-line part of the overall oven layout. The materials handling system was designed to permit work to pass directly from spray booth into oven for three passes under infra-red radiant heating lamps.

ADVANTAGES: Faster drying, finishing and prolonged curing cycles that answered every flexibility demand. Variable control of lamp banks and conveyor speeds gives a wide range of work time in the oven extending from 3 to 7 minutes. BECAUSE OF THIS LONGER WORK CYCLE IN OVEN—OPERATING COSTS ARE HELD AT ROCK BOTTOM.

AFTER THE WAR, *without alteration*, this same unit will be paying dividends in the efficient, low cost enamel baking of sealed-beam headlamp housings, headlamp shells, doors and other sheet metal stampings.

Learn what a *Productioneered* Hall RADIAIR Oven can save you in valuable finishing TIME—wartime minutes today—peacetime minutes tomorrow.

C·M·HALL *Lamp Company*

PIONEER DESIGNERS AND BUILDERS OF INFRA-RED RADIANT HEATING EQUIPMENT

1035 EAST HANCOCK ST. DETROIT 7, MICHIGAN

SIMPLIFIED SPEED CONTROL

A feature of
HENDY TURBO-GENERATORS

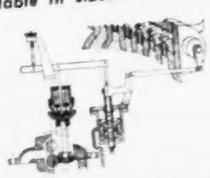
HENDY'S simplified governor system will pay you dividends

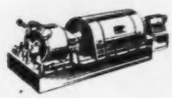
This governing system is positive in action—and extremely sensitive from no load to overload. It is a simplified and compact unit of the oil-relay and centrifugal type. An overspeed trip mechanism within the governor assembly automatically closes the throttle at 110% normal speed. Additional safety is provided by the hand-operated emergency trip button which, because of its location and method of operation, effectively prevents accidental tripping and purposeless shutdown.

Another new design feature of this governor system makes synchronization easy; through the use of a vernier-type screw, turbine speed-load characteristics can be accurately adjusted within a range of 5% above or below normal.

This simplified governor system is only one of many advanced Hendy features that pay you dividends in lower maintenance costs and efficient operation. Details of other dividend-paying features will follow in succeeding advertisements.

Hendy turbo-generators are available in sizes from 250 to 750 kw. When requesting detailed information, please indicate electrical requirements, steam conditions, and type of service involved. Phone or write your nearest Hendy office.





Because this new Hendy Turbo-generator is *simplified,* it is dependable and efficient. Not only have general characteristics been bettered, but individual parts have also been improved—made *simpler* and more dependable through ingenious design.

This is true of the set throughout. Turbine, reduction gear, and generator—all were designed and built as *matched* units. And *all* are built by Hendy, giving you complete power equipment from *one* responsible source.

Here are just a few of the features of this set: an extremely accurate governor mechanism that reduces maintenance because it has no packing or stuffing boxes . . . easy accessibility to all parts subject to wear or replacement . . . neat, trim contours and reduced external piping, made possible by the placement of filters, strainers, and controls in protected locations. These, and the many other features of this turbo-generator, combine to make a smooth-running, dependable power plant for a wide variety of industrial applications.

JOSHUA HENDY IRON WORKS
ESTABLISHED 1856
SUNNYVALE, CALIFORNIA

62-TG-7

Branch Offices: **BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND • DETROIT • NEW YORK • PHILADELPHIA • PITTSBURGH • SAN FRANCISCO • ST. LOUIS • WASHINGTON**

TURBO-GENERATORS

REDUCTION GEARS

STEAM TURBINES

DIESEL ENGINES

★ NUMBER 16 IN A SERIES OF MESSAGES BY KELLETT AIRCRAFT CORPORATION ★

OVER ROOF-TOPS OR MASTHEADS!

Able to fly high or low, fast or slow—even reverse! – the helicopter of tomorrow will be ideally suited for many post-war air services. Its ability to hover in the air, back up, move sideways, descend or rise vertically and land in a small area, will add many new applications to the already great facilities of conventional air transport. Deck operation, from seagoing vessels, is one of these.

Kellett has been logging hours of helicopter flight . . . valuable experience which will be available for a variety of future civilian uses. Right now all Kellett production is for our military forces. Later on, Kellett helicopter developments may be expected to expedite "flying without wings" over roof-tops and mastheads, over forests, plains and farmlands!

INTERESTING FREE BOOKLET

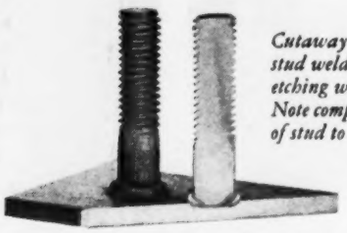
"Answering Some Helicopter Questions" brings you many interesting facts about the modern helicopter and its present capabilities. Write to Kellett Aircraft Corp., Dept. E, Upper Darby (Phila.), Pennsylvania.

KELLETT

OLDEST ROTARY WING AIRCRAFT MANUFACTURING COMPANY

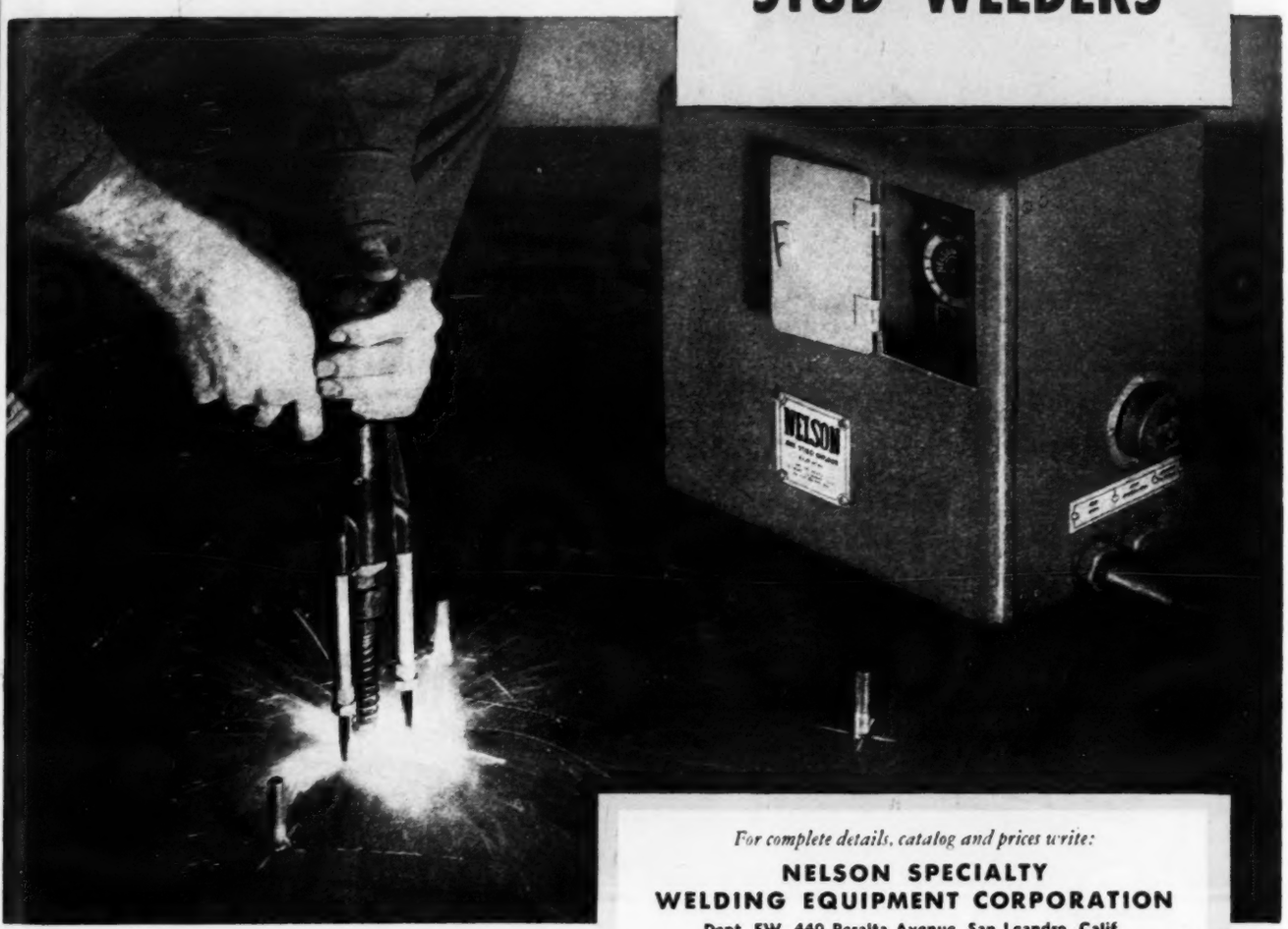
Automatically end-weld studs!

- **Complete fusion between stud and metal in ½ second . . . Saves time.**
- **No drilling holes or hand-welding bolts. Studs are pointed for accurate locating.**
- **One operator can weld more than 1000 studs per shift. Completely portable. Also available as a production jig.**
- **Thousands of guns now being used in more than 500 shipyards and industrial plants.**



Cutaway view of stud weld after etching with Nital. Note complete fusion of stud to metal.

NELSON
ELECTRIC ARC
STUD WELDERS



End-welding a stud to metal plate.

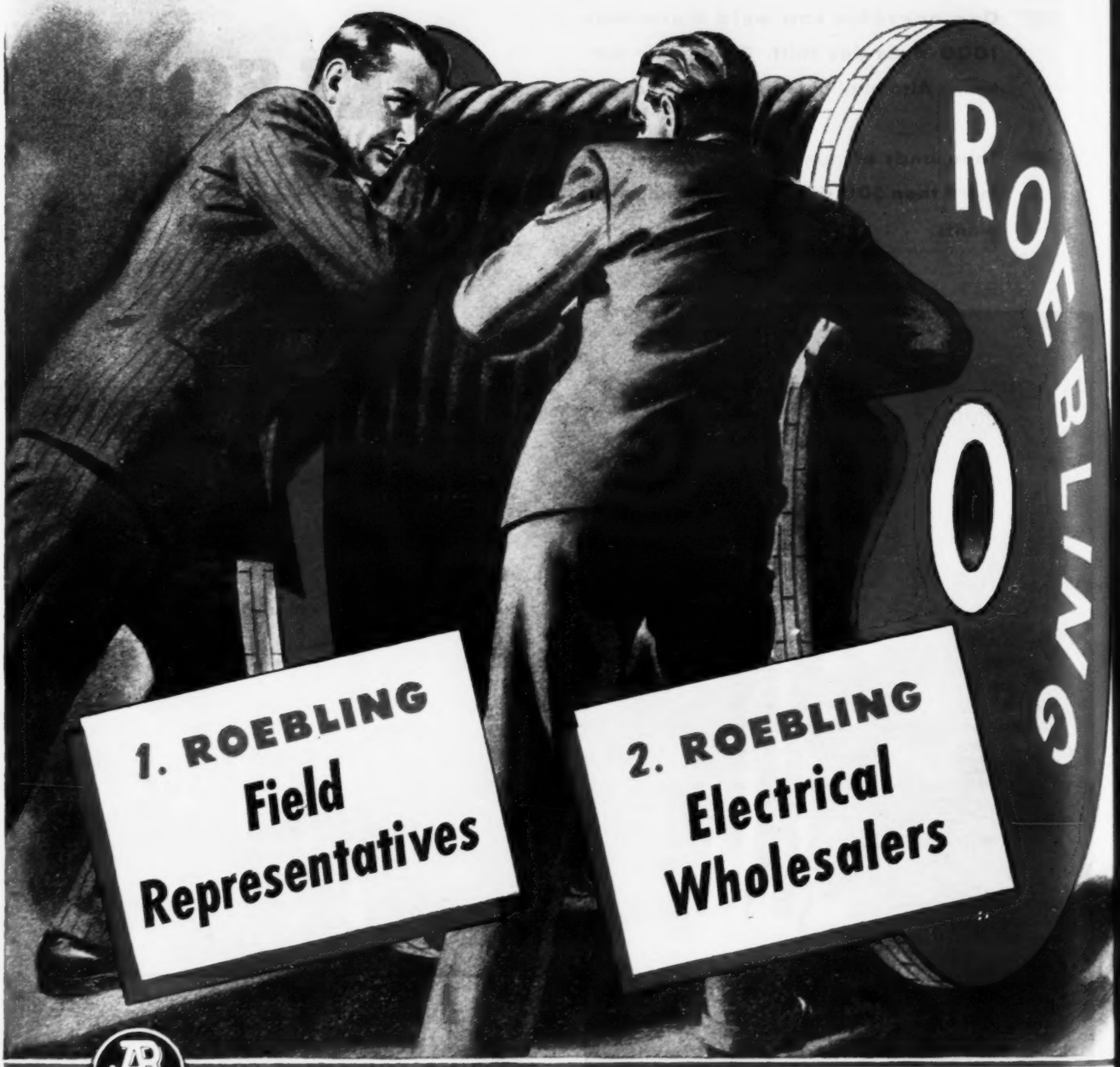
For complete details, catalog and prices write:

NELSON SPECIALTY WELDING EQUIPMENT CORPORATION

Dept. EW, 440 Peralta Avenue, San Leandro, Calif.

Eastern Representative: Camden Stud Welding Corp. Dept. 122, 1416 South 6th Street, Camden, N. J.

ROE



JAR ROEBLING

PACEMAKER

BLINC

Two Shoulders to the Reel!

TO GIVE YOU THE BEST IN PRODUCTS AND SERVICE

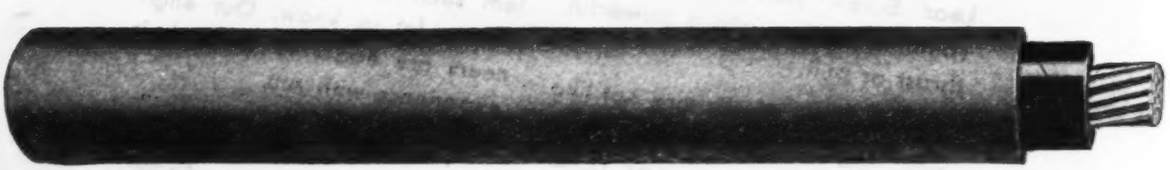
PRODUCT AND SERVICE are the two most important factors in buying—and you get them *both* from this combination. Your Roebling Electrical wholesaler is doing a great job, even with all the trials and tribulations of increased demand and limited supplies. Your Roebling Field Engineer is qualified by "Know What", and "Know How" to consult and advise on specialized problems.

You can always turn with confidence to your local Roebling Electrical Wholesaler.

JOHN A. ROEBLING'S SONS COMPANY
TRENTON 2, NEW JERSEY
Branches and Warehouses in Principal Cities

ROEBLING WIRES AND CABLES

WIRE ROPE AND STRAND • FITTINGS • SLINGS • WIRE CLOTH AND NETTING • COLD ROLLED STRIP HIGH AND LOW CARBON ACID AND BASIC OPEN HEARTH STEELS • ROUND AND SHAPED WIRE • AIRCORD, SWAGED TERMINALS AND ASSEMBLIES • AERIAL WIRE ROPE SYSTEMS • SUSPENSION BRIDGES AND CABLES ELECTRICAL WIRES AND CABLES



IN WIRE PRODUCTS

A BETTER WAY TO TRANSMIT POWER

Here is a way to transmit power through congested space and produce linear motion at a distant point. It is with Lear Flexible Shaft systems. These systems can provide power to a space so small that it would not permit the use of even the small Lear Actuator.

In these systems, a Lear Power Unit is mounted where space permits and Lear Flexible Shafting carries the force to points where motion is required. Here Lear Screw Jacks convert the spinning motion into a powerful thrust or pull.

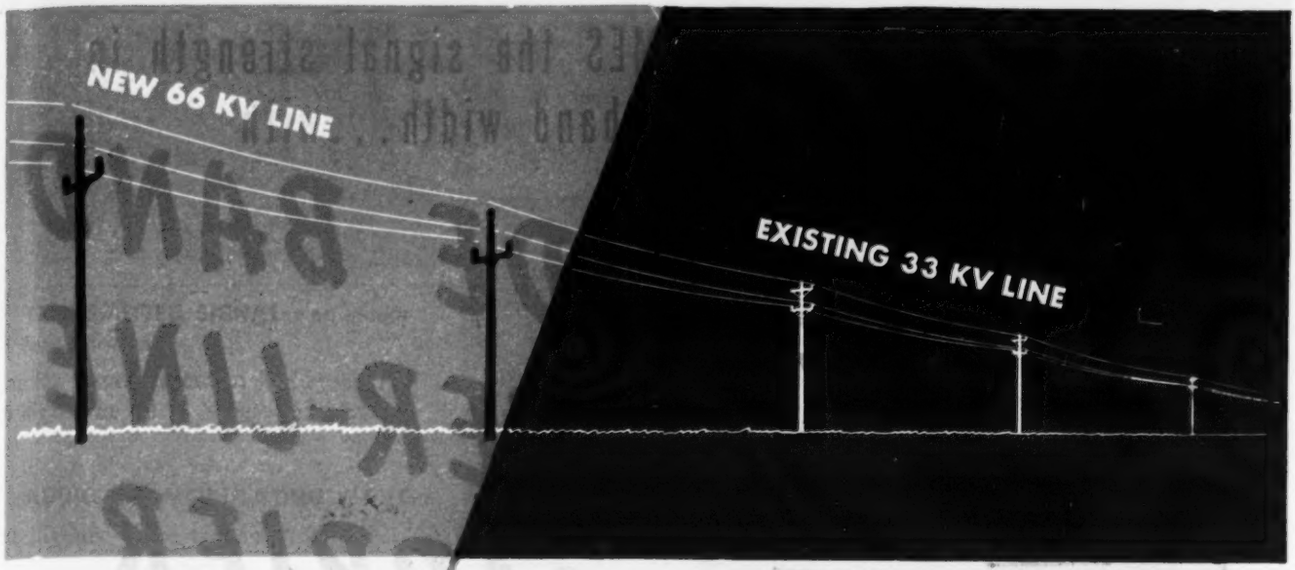
Lear Flexible Shafts are not like any you've seen before. They reliably handle power rotating either way. They're strong. Installation is easy and not expensive. They have no exposed moving parts. They can do the work of solid shafts, torque tubes, pulleys, linkages, sprockets, belts and chains.

The days to come are going to bring a lot of difficult power-transmission and control problems in all kinds of industry. And probably Lear Flexible Shaft systems will solve many of them.

So we're telling you about them now. If you're faced with a problem such as we've indicated, please let us know. Our engineers are eager to share their experience with you.

Lear INCORPORATED

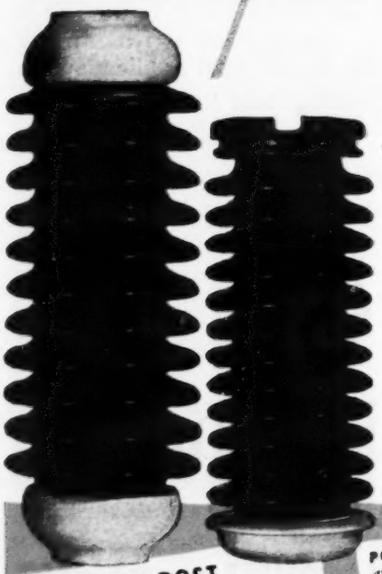
LEAR, Incorporated—Piqua, Ohio—*formerly Lear Avia, Inc.*



LINE CONVERSION WITH LAPP LINE POSTS

is the fastest way to fortify your system.... and uses least materials

New or increased load demands frequently can most efficiently be handled by conversion of existing lines to higher voltage. For this job, Lapp Line Posts are particularly suited. Using present sound poles and conductors, conversion to higher voltages can be accomplished with no more than new cross-arms and Lapp Line Posts. Nor need such construction be considered as an emergency temporary expedient. Such a line approaches the current ideal for a new line; and your Lapp Posts can be expected to give trouble-free service for a longer period of years than you ever got from conventional insulators.



LAPP LINE POST and STATION POSTS on your system offer..

POWER ARCOVER. *Flashover and leakage distances are not appreciably lowered by damage —even loss of several petticoats.*

NO PUNCTURE. *Puncture path in Lapp Post design is as great as flashover path. Insulator will flash over rather than puncture.*

NO CRACKING. *One piece post body, not subject to bursting from tension strains created by thermal changes in nested parts.*

RADIO INTERFERENCE. *By virtue of design factors alone, radio interference is permanently prevented at rated neutral voltage.*

NO CLEANING. *Fog-type design preserves uniform leakage path, prevents leakage flashover, makes the unit "self-cleaning."*

MECHANICAL RUGGEDNESS. *Stones or bullets deflect off, or rupture petticoats, leaving post body intact and insulator secure.*

Lapp

LAPP INSULATOR COMPANY, INC., LE ROY, N. Y.

NOW... EIGHT TIMES the signal strength in HALF the band width...with

SINGLE SIDE BAND POWER-LINE CARRIER

SINGLE SIDE BAND EASILY OBTAINED

Existing Westinghouse Type JY amplitude-modulated equipment can be converted to Single Side Band transmission by addition of a standard panel to transmitters and receivers. Where present needs can be met by installing Type JY (AM) equipment, Single Side Band conversion equipment can be added at any time as narrower channels and better signal-to-noise ratio are required.

Now available for the first time in practical, simplified form—Single Side Band Power-Line Carrier:

DOUBLES the number of channels available for carrier use. This is the answer to the ever-increasing problem of carrier-spectrum crowding which many users are experiencing.

PROVIDES higher signal-to-noise ratio than any other system occupying double the channel width.

ELIMINATES carrier heterodynes and corona modulation of carrier.

Single Side Band has its principal applications in communication, telemetering, and load control, and for a combination of these functions. It is particularly advantageous where transmission is over long distances and where noise and interference conditions are bad.

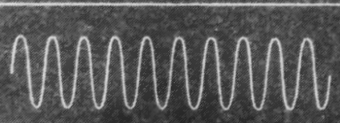
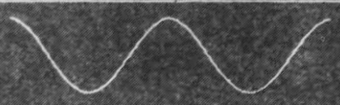
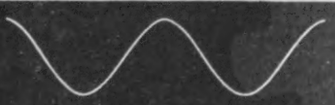
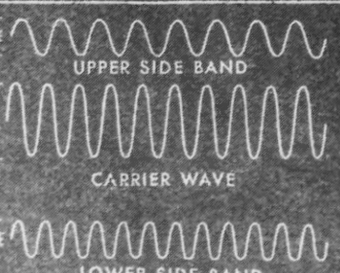
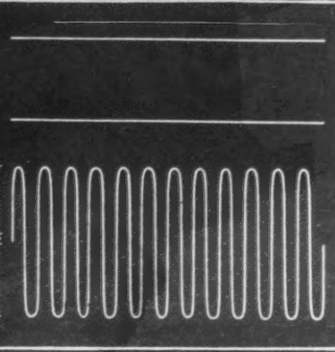
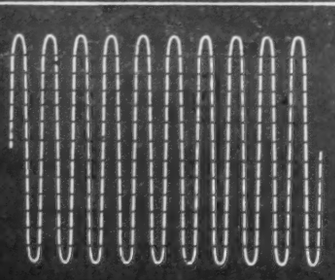
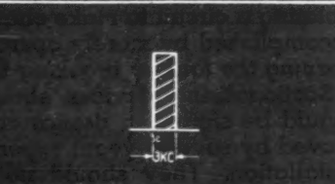
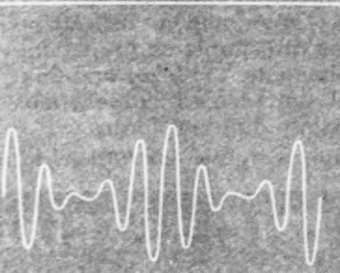
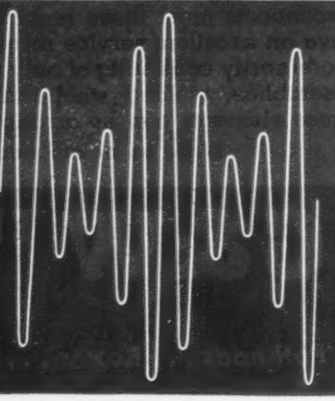
J-97090

Westinghouse

CARRIER

ENGINEERED . . . BUILT . . . TESTED TO *MATCH* POWER-LINE STANDARDS

HOW THE SYSTEM OPERATES

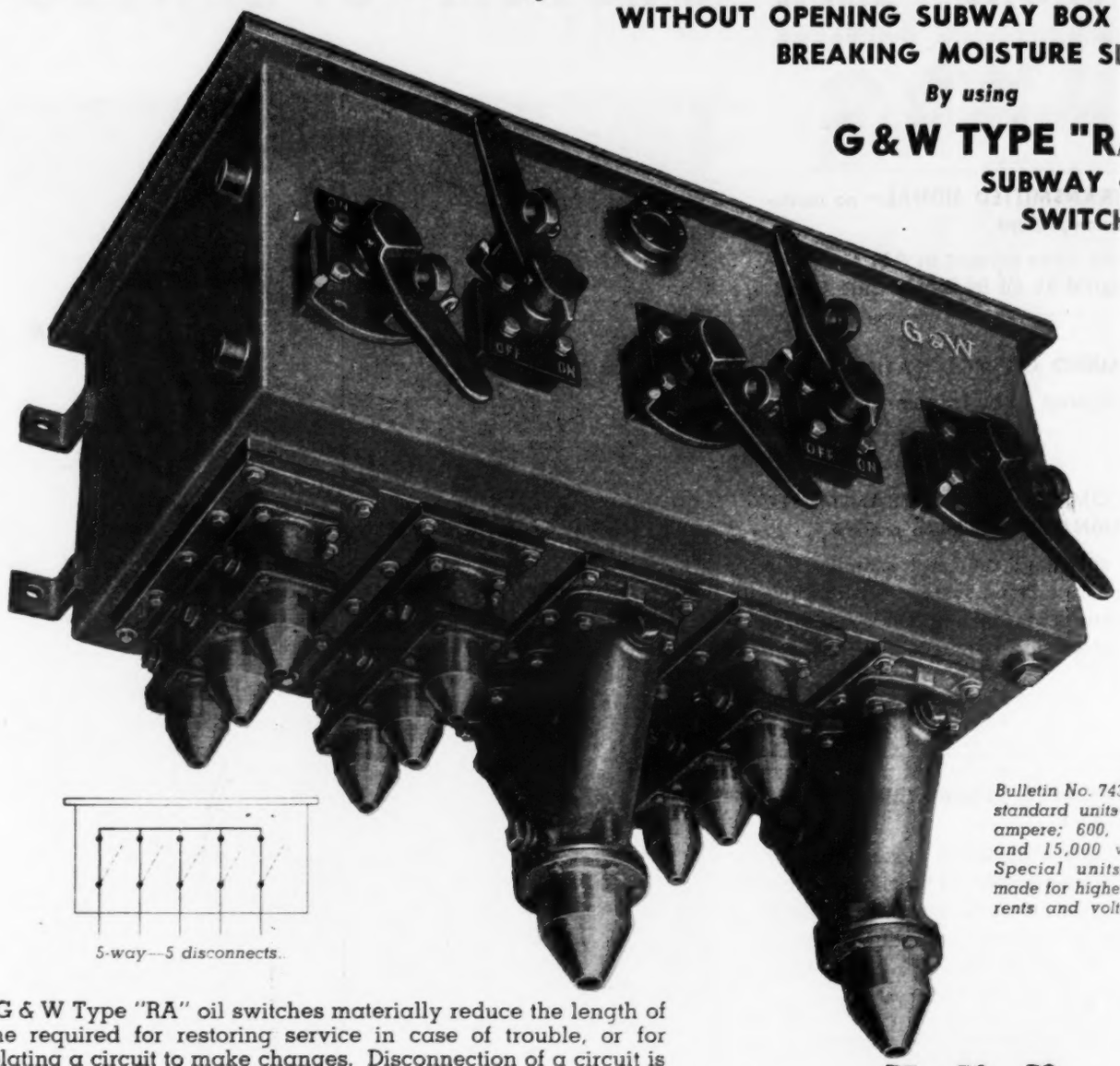
	AMPLITUDE MODULATION SYSTEM	SINGLE SIDE BAND SYSTEM
1. TRANSMITTED SIGNAL— ***no modulation present*** Carrier wave present in AM system—no signal at all in Single Side Band.		
2. AUDIO OR MODULATING WAVE Intelligence to be transmitted.		
3. COMPONENTS OF TRANSMITTED SIGNAL— ***modulation present*** One side band only is transmitted in Single Side Band system, with amplitude equal to total amplitude of carrier and both side bands in AM system.		
4. LOCALLY GENERATED CARRIER WAVE In Single Side Band system, carrier wave is generated at receiving end—not transmitted. As a result, very low power is required to produce equivalent of carrier wave received from other end in the AM system.		
5. BAND WIDTH REQUIRED Single Side Band signals occupy half the band taken by AM. Reducing receiver band width eliminates half the accepted noise power.		
6. RESULTING SIGNAL RECEIVED Sum of incoming side band and locally generated carrier produces a signal in the Single Side Band system equivalent to the AM signal—but with four times the power variations and half the noise, the equivalent of increasing the AM carrier power 8 times.		

Disconnect underground cable circuits

WITHOUT OPENING SUBWAY BOX OR BREAKING MOISTURE SEAL

By using

G&W TYPE "RA" SUBWAY OIL SWITCHES



5-way—5 disconnects.

Bulletin No. 743 lists standard units—400 ampere; 600, 7,500 and 15,000 volts. Special units are made for higher currents and voltages.

G & W Type "RA" oil switches materially reduce the length of time required for restoring service in case of trouble, or for isolating a circuit to make changes. Disconnection of a circuit is accomplished by merely operating an external handle—*without opening the tank or breaking the seal.*

Sectionalizing devices should be safe and reliable — they should be simple in design and construction — they should be proved by several years experience under various conditions of installation. They should not fail to function properly even though they may not be operated over long periods of time.

G & W Type "RA" oil switches and multiple circuit subway oil disconnects meet these requirements. Originated in 1928, they have an excellent service record. They are simple and practical —ordinarily consisting of only three elements . . . rocker arm link assemblies, welded steel tanks and unit sealed cableheads. These elements can be arranged in many different forms.

Write us or our nearest representative for further data.

ROCKER ARM LINKS

Self-aligning floating contact links are encased in porcelain bushings which are in turn clamped between impregnated wood straps. The links pivot on one set of stationary contacts.

G&W ELECTRIC SPECIALTIES

Originators and pioneers of equipment for sound methods of underground and overhead electric distribution.

G&W ELECTRIC SPECIALTY CO.

7780 DANTE AVE., CHICAGO 19, ILL., U. S. A.

Also made in Canada by Powerlite Devices, Ltd., Toronto

Potheads . . . Boxes . . . Oil Fuse Cutouts . . . Oil Switches . . . Multiple Circuit Disconnects

JUST PUSH A BUTTON . . . AND SCHRAMM COMPRESSORS GIVE A STEADY FLOW OF AIR!

Yes — easily and quickly — a few minutes after you put Schramm Air Compressors on the job . . . you get a steady flow of air *at the pressure you want it!*

Utilities use Schramm—not only for general field service—but in the steam plants, generating stations, repair shops.

Schramm Compressors are compact, light-weight, and available in any truck or trailer-type mounting.

Check these under-the-hood features:

1 *Completely watercooled to provide ideal performance in winter as well as summer.*
2 *Main Bearings for every cylinder.*
3 *Mechanical Intake Valve.*
4 *More Cylinders and lighter parts.*
5 *Forced feed lubrication.*

Details of Schramm Compressors, and the advantages they offer, are contained in a new, fully illustrated booklet—yours for the asking. *Write today for your free copy of Bulletin PUB-44.*

SCHRAMM INC.

THE COMPRESSOR PEOPLE
WEST CHESTER
PENNSYLVANIA

Nicopress

REINFORCING SLEEVES ARE SPECIALLY MADE FOR STRENGTHENING DAMAGED COPPERWELD-COPPER CONDUCTORS

THESE SLEEVES ARE SPLIT THE FULL LENGTH AND MAY BE slipped over the damaged section and compressed with the same Nicopress Tool used in making the regular line splice.

THE NATIONAL TELEPHONE SUPPLY COMPANY

The National Telephone Supply Company

5100 SUPERIOR AVENUE • CLEVELAND 3; OHIO

Canadian Mfr.—N. SLATER CO., LTD., HAMILTON, ONT., CANADA

Export Distributor—INTERNATIONAL STANDARD ELECTRIC CORP., NEW YORK, N. Y.

GOOD OIL
+
BAD OIL
=
BAD OIL
4 OZ
New oil added to system . . .
. . . plus oxidized oil, solid contaminants and water in a very short time produce . . .
. . a batch of oil thoroughly contaminated due to the auto-catalytic nature of oil deterioration.

"The presence of as little as 10% of used turbine oil can reduce the life of the new charge by as much as 75%"

KEEP YOUR TURBINES *SWEET-RUNNING* WITH THE NEW SHELL CLEANING PROCEDURE

It's open-and-shut—no if's, and's, or but's . . .

Add clean oil to dirty oil and you get—*dirty oil*

Add clean oil to a lubricating system that's contaminated with sludge, rust, metal chips and other foreign matter and you get—*dirty oil.* **Either way, you lose.**

In fact, unless the system is thoroughly clean, you're throwing away good dollars every time you install a new oil charge.

The new Shell Turbine Cleaning Procedure saves time and money; it assures thorough cleaning, increased oil life, less frequent shutdowns, better over-all operation.

The procedure is simple, foolproof . . . first a solvent cleaner—Shell Turbo Cleaner. This dissolves the products of oil deterioration, helps remove contaminants.

Then, a displacement oil with final draining to wash away the used Shell Turbo Cleaner, to insure complete cleaning.

Phone, wire or write Shell Oil Company, Inc., 50 W. 50th St., New York 20, N. Y. or 100 Bush Street, San Francisco 6, Calif.

Send for this booklet now!

Every turbine owner and operator should have a copy of the Shell Turbine Cleaning Manual. It tells how—simply and clearly—to keep turbines clean and sweet-running.

SHELL

SHELL TURBO OIL

Nicopress

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SHELL

SHELL TURBO OIL

Roller-Smith Benchboard *controlling 4 kv, 12 kv and 23 kv switchgear consisting of tie line, transformer bank and feeder circuits. 93 a-c and d-c switchboard instruments and 36 rotary switches also built by Roller-Smith.*

Back of the design of every switchgear unit built by Roller-Smith are 4 fundamentals that we believe are vital. They are:

1. *Safety to operator and equipment*
2. *Simplicity of operation*
3. *Reliability in service*
4. *Ease of Maintenance*

Roller-Smith Metal-Clad Switchgear is tailored to meet the conditions of each particular application. As a result of this policy new features are constantly being added to the many time-proved standard features which include: molded bus insulation; full-floating self-aligning secondary contacts; high pressure self-aligning finger-type primary disconnects; individual enclosures, Bakelite isolated.

Before specifying any type of switchgear it will pay you to become acquainted with what Roller-Smith can offer. Let us furnish complete information.

ROLLER SMITH

Sales Representatives In all Principal Cities

ROLLER-SMITH BETHLEHEM, PENNA.

Canadian Plant: ROLLER-SMITH MARSLAND, LTD., Kitchener, Ontario

STANDARD AND PRECISION ELECTRICAL INSTRUMENTS • AIRCRAFT INSTRUMENTS • SWITCHGEAR • AIR AND OIL CIRCUIT BREAKERS • ROTARY SWITCHES • RELAYS • PRECISION BALANCES

LOOK FOR *MORE* THAN THIS

When You Select Suspension Insulators

All suspension insulators regardless of make are pre-tested to a certain percentage of their guaranteed minimum mechanical strength. Locke insulators are tested to a full 50% of their rating. Consequently, few suspension insulators—and no Locke suspension insulators—will fail except from some outside impact.

Unfortunately, there are many insulators—even up in the top M&E brackets—which cannot withstand the accidental blows encountered in construction, a bullet from a 22 rifle or even a kid's well aimed rock, so before you select a suspension insulator, CHECK THE IMPACT STRENGTH.

Increased impact resistance strengths—the outcome of a comprehensive program of research in the properties of glaze conducted in the Locke research laboratories—have been a feature of Locke suspension insulators since 1935.

For speedier construction with less insulator breakage, lower maintenance and replacement rates, longer life in service, more uniform strengths, always specify Locke Suspension Insulators.

LOCKE *Insulator Corporation*

BALTIMORE • • MARYLAND

EVER THINK OF A FLUORESCENT TROFFER LIGHTING SYSTEM AS A STRUCTURAL AID ?

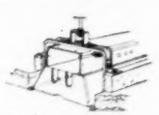
In designing stores, offices, schools and public buildings...

lighting is no longer a comparative afterthought. It is an integral part of the design and construction, and—in the case of Miller Fluorescent Troffer Lighting Systems—*is a definite structural aid!*

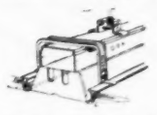
For instance, it is no longer necessary to block in a ceiling and then waste expensive hours cutting, adjusting and readjusting until the fixtures fit and hang as intended.

Instead, Miller Fluorescent Troffer Lighting Systems hang directly from the structural ceiling —and the false ceiling, which is hung from the lighting system, can be quickly filled in.

This patented Miller Bracket makes it possible:



Miller Bracket for wood-frame ceilings.



Miller Bracket for metal-frame ceilings.

Other structural aids include: Reduction of 50 to 75% in needed supports from structural ceiling . . . outlet movement minimized or eliminated . . . conduit and conduit fitting costs reduced up to 80% . . . wiring costs reduced up to 50%. And they all combine to make Miller Fluorescent Lighting Systems the most practicable to install.

And the most *flexible* for esthetic design and functional planning!

Miller Troffers fit the picture as single units or in blocks, geometric patterns and even as light strips "by the mile." Their wide range of plastic and glass lenses, plates, and metal or plastic grilles harmonize with any type interior.

In fact, so versatile are Miller Fluorescent Troffer Lighting Systems that they *suggest* themes around which entire interiors may be planned.

So call a Miller Representative (they're in principal cities) and see how our 100 years experience with all proven light sources can serve you!

THE MILLER COMPANY • MERIDEN, CONNECTICUT

ILLUMINATING DIVISION
Fluorescent, Incandescent & Mercury Lighting Equipment

OIL GOODS DIVISION
Domestic Oil Burners and Liquid Fuel Devices

ROLLING MILL DIVISION
Phosphor Bronze and Brass in Sheets, Strips and Rolls

WAR CONTRACTS DIVISION
War Materiel

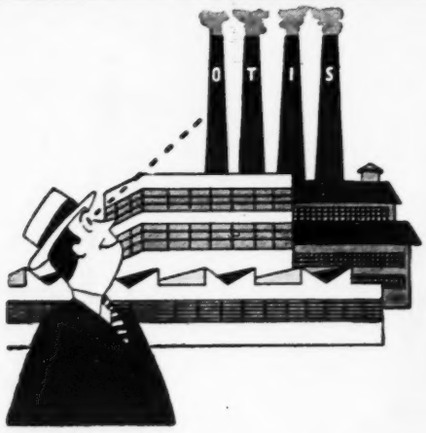
MILLER SINCE 1844

WIRES DOWN!
But RCA Emergency Radio can fly through the air with the greatest of ease — and get your nearest trouble truck on the job
A WELL-PLANNED 2-way radio system for emergency communications is the answer to many electric light and power company problems directly important to public safety and service.
When your wires go down by storm, ice, flood or fire, an RCA 2-Way Radio System can be of enormous assistance in quick restoration of service—quick elimination of hazards from broken or grounded wires and cables.
Resolve that RCA 2-Way Radio will be a must in your postwar program. Make your plans now. RCA engineers will gladly help you.
AM or FM—RCA makes *both*.
AM or FM
RCA MAKES BOTH
BUY MORE WAR BONDS
RCA
RADIO CORPORATION OF AMERICA
RCA VICTOR DIVISION • CAMDEN, N. J.
In Canada, RCA Victor Company Limited, Montreal

THE WAR...
YOUR ELEVATORS...
AND YOUR EYES

1. On flat-tops, battleships, and cruisers, Otis precision-built elevators have been and are today serving the United States Navy on the seven seas. From our experience in providing this equipment have come marked improvements in design, new manufacturing techniques, and a store of knowledge destined to provide still further improvements in Otis Elevators after the war.

2. Today, therefore, when planning the modernization of your present equipment, give particular consideration to Otis Elevators. This company, with 244 offices throughout the United States, is in a position now to cooperate with you in the preparation of plans and surveys.



3. *So, keep your eyes on Otis.* In the days ahead, this company, through the continued use of advanced methods and new skills, will, as in the past, be ready to assure you of the last word in efficient and economical vertical transportation.

Remember, there is an Otis representative as near as your telephone. He will be glad to discuss future plans for new elevator or escalator installations or the modernization or maintenance of existing equipment. Call him today.

Otis ELEVATOR COMPANY

OFFICES IN ALL PRINCIPAL CITIES

The accumulated experience of 35 years of four-wheel-drive leadership is embodied in this FWD Model HAR . . . a truck endorsed by owners, in just four years, to the extent of 50 million dollars in purchases.

A Handsome Line of Truly Great Trucks that

FWDs

HAUL LONGER FOR LESS

Like all FWDs in the complete range from 2½ to 15-ton trucks, the FWD model HAR commands the respect of all who know quality. Its fine appearance speaks for superior power, ruggedness, performance without waste, and ability to HAUL LONGER FOR LESS!

Figure less depreciation, more years, more mileage for FWDs. Figure less upkeep and operating costs. Balanced weight distribution and the four-wheel-drive principle reduce driving strain 50% on each axle. Figure less tire cost . . . equalized power distribution and balanced load on all four wheels prevent the slips, skids, slues and scuffs that tear down tires. Figure less fuel cost . . . 88.2% of engine power goes to move payloads . . . with power in all four wheels. Figure less cost-per-ton-mile . . . wide range of gear ratios and FWD traction on all wheels permit more speed on hills, curves and tough roads. ☆ Figure FWDs in the future, too, to haul longer for less.

THE FOUR WHEEL DRIVE AUTO CO., Clintonville, Wis. *Canadian Factory: Kitchener, Ontario*

A LIMITED NUMBER OF FWDs AVAILABLE THIS YEAR. Phone, wire or write us, or see the nearest authorized FWD dealer for priority data.

This FWD has a successful service record on duty with Los Angeles Bureau of Power & Light.

FWD trucks are the first choice of more than 150 public utilities for line construction and maintenance.

FWD TRUCKS

THE ORIGINAL EXCLUSIVE BUILDERS OF FOUR-WHEEL-DRIVE TRUCKS

THE WAR... YOUR ELEVATORS... AND YOUR EYES

1. On flat-tops, battleships, and cruisers, Otis precision-built elevators have been and are today serving the United States Navy on the seven seas. From our experience in providing this equipment have come marked improvements in design, new manufacturing techniques, and a store of knowledge destined to provide still further improvements in Otis Elevators after the war.

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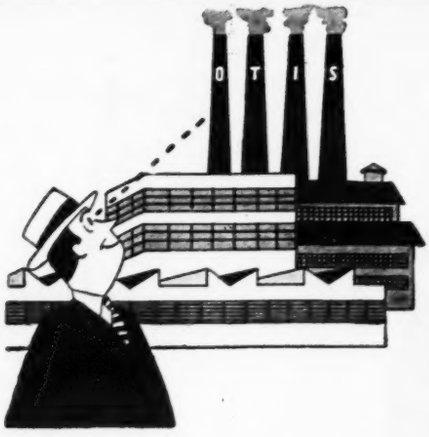

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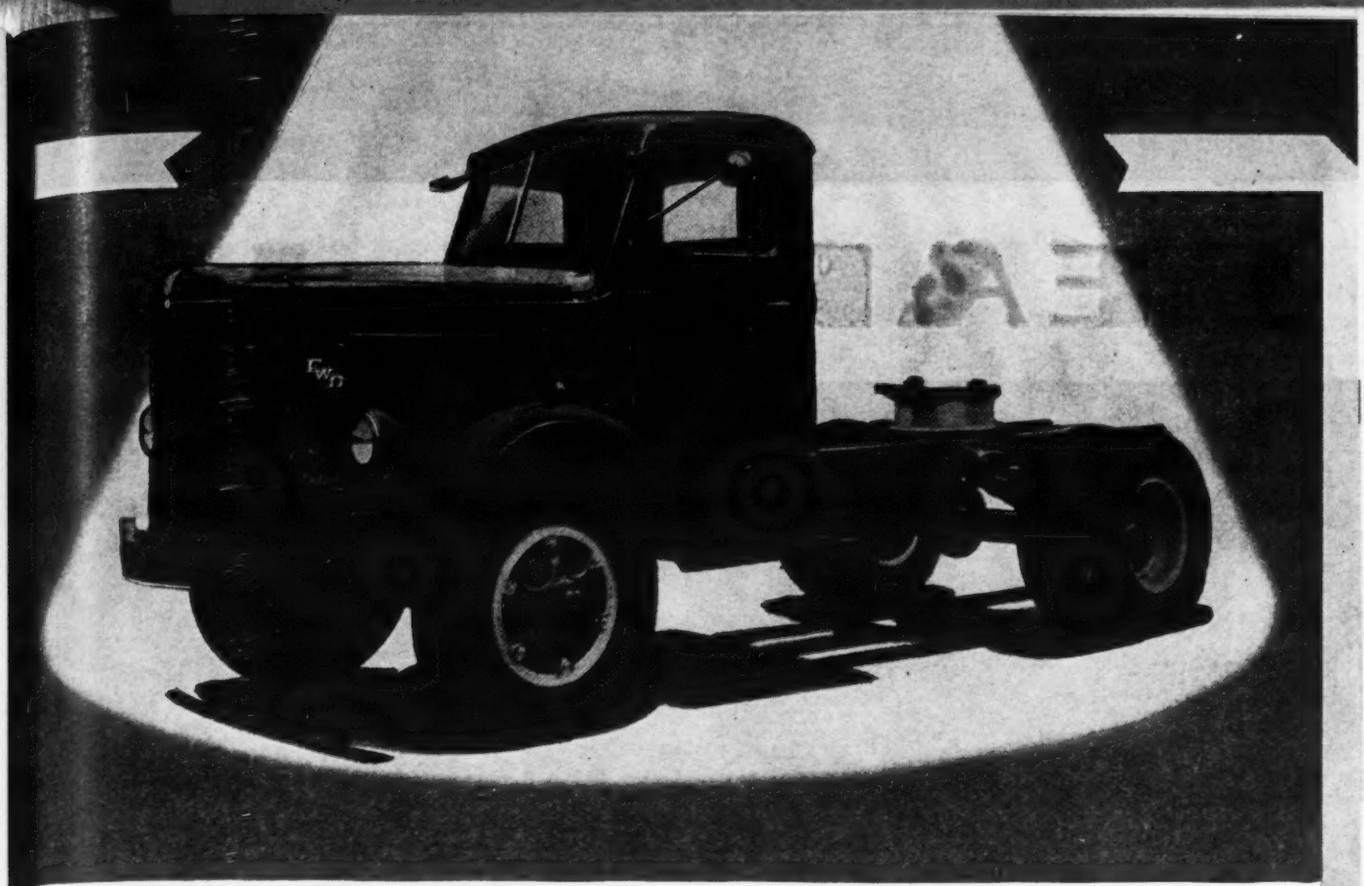
Otis ELEVATOR COMPANY

OFFICES IN ALL PRINCIPAL CITIES



The accumulated experience of 35 years of four-wheel-drive leadership is embodied in this FWD Model HAR . . . a truck endorsed by owners, in just four years, to the extent of 50 million dollars in purchases.

A Handsome Line of Truly Great Trucks that

FWDs

HAUL LONGER FOR LESS

Like all FWDs in the complete range from 2½ to 15-ton trucks, the FWD model HAR commands the respect of all who know quality. Its fine appearance speaks for superior power, ruggedness, performance without waste, and ability to HAUL LONGER FOR LESS!

Figure less depreciation, more years, more mileage for FWDs. Figure less upkeep and operating costs. Balanced weight distribution and the four-wheel-drive principle reduce driving strain 50% on each axle. Figure less tire cost . . . equalized power distribution and balanced load on all four wheels prevent the slips, skids, slues and scuffs that tear down tires. Figure less fuel cost . . . 88.2% of engine power goes to move payloads . . . with power in all four wheels. Figure less cost-per-ton-mile . . . wide range of gear ratios and FWD traction on all wheels permit more speed on hills, curves and tough roads. ☆ Figure FWDs in the future, too, to haul longer for less.

THE FOUR WHEEL DRIVE AUTO CO., Clintonville, Wis. *Canadian Factory: Kitchener, Ontario*

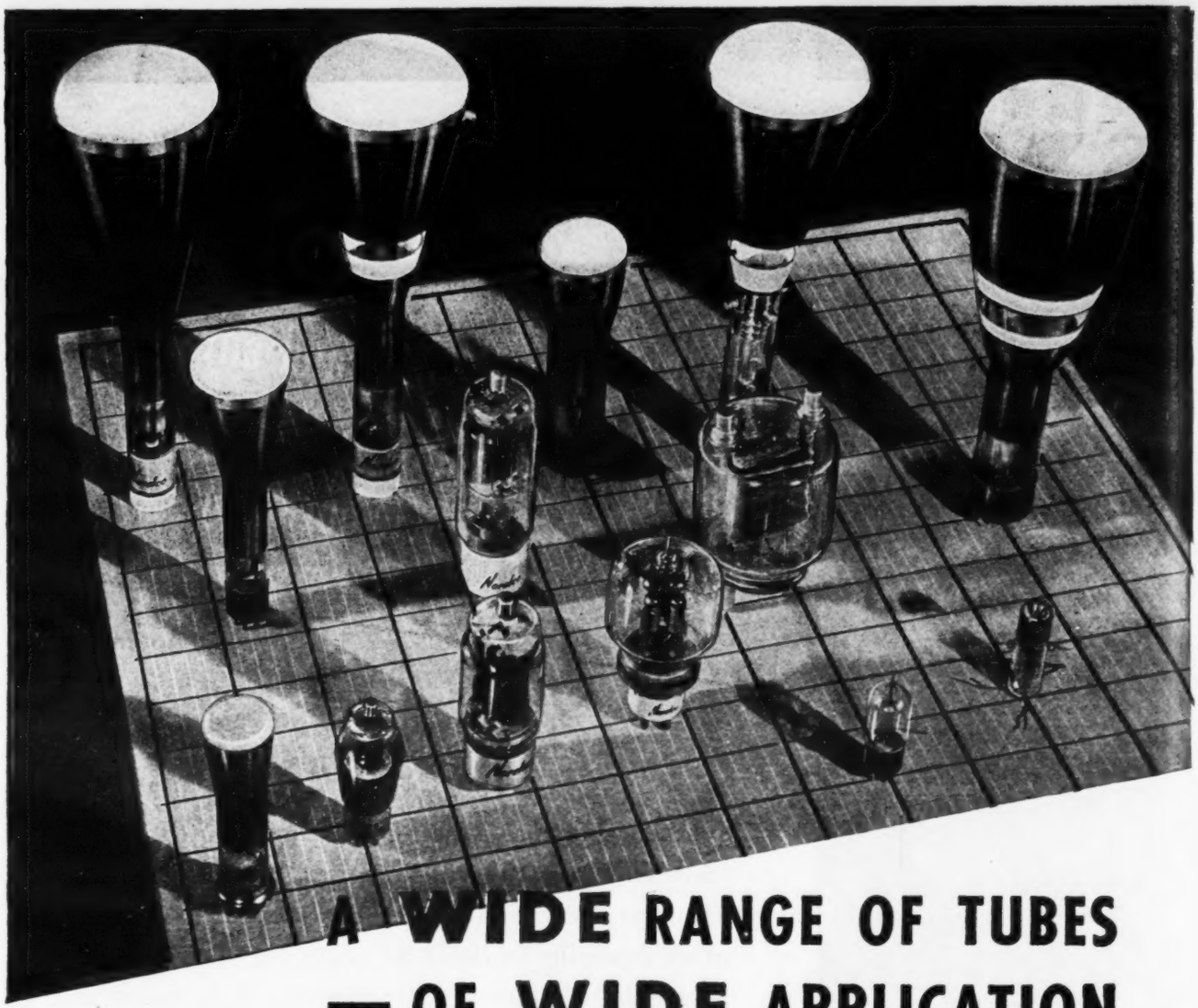
A LIMITED NUMBER OF FWDs AVAILABLE THIS YEAR. Phone, wire or write us, or see the nearest authorized FWD dealer for priority data.

This FWD has a successful service record on duty with Los Angeles Bureau of Power & Light.

FWD trucks are the first choice of more than 150 public utilities for line construction and maintenance.

FWD TRUCKS

THE ORIGINAL EXCLUSIVE BUILDERS OF FOUR-WHEEL-DRIVE TRUCKS



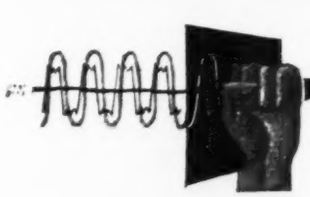
A WIDE RANGE OF TUBES —OF WIDE APPLICATION

THE enviable engineering tradition on which the foundation of the North American Philips Company, Inc., rests, is reflected in the superior quality and performance of electronic tubes bearing the NORELCO stamp. Contributing to the long life and uniform characteristics of these tubes are many exclusive manufacturing techniques and inspection methods developed over a long period.

Among the types we now manufacture—some of which are illustrated—are a number of special-purpose, cathode-ray and transmitting tubes for high and ultra-high frequency applications, r-f and a-f power amplifier tubes, and low- and high-power rectifiers. Although all the tubes we produce now go to the armed forces, we invite inquiries from prospective users. A list of the tube types we are especially equipped to produce will be sent on request.

In the North American Philips Company, there is gathered together a team of outstanding electronic engineers, coached by a group with world-wide experience resulting from fifty years of research and development in the electrical field. This new combination of technical talent has at its command many exclusive processes that insure electronic devices of the highest precision and quality. Today, North American Philips works for a United Nations Victory; tomorrow, its aim will be to serve industry.

OTHER PRODUCTS: In addition to the electronic tubes mentioned above we make Quartz Oscillator Plates; Searchray (X-ray) Apparatus, X-ray Diffraction Apparatus; Medical X-ray Equipment, Tubes and Accessories; Tungsten and Molybdenum products; Fine Wire; Diamond Dies.



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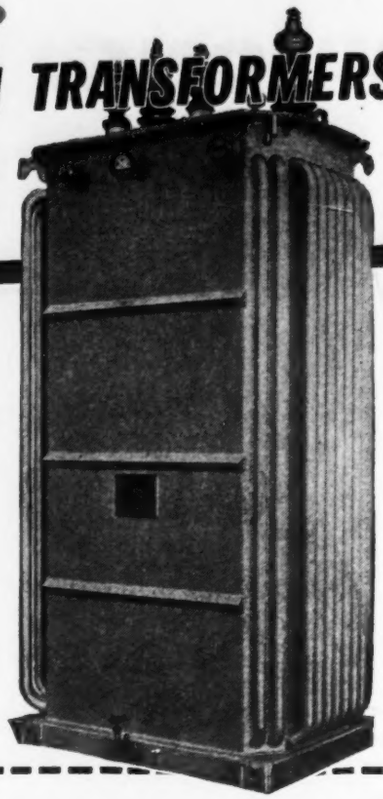
Wagner

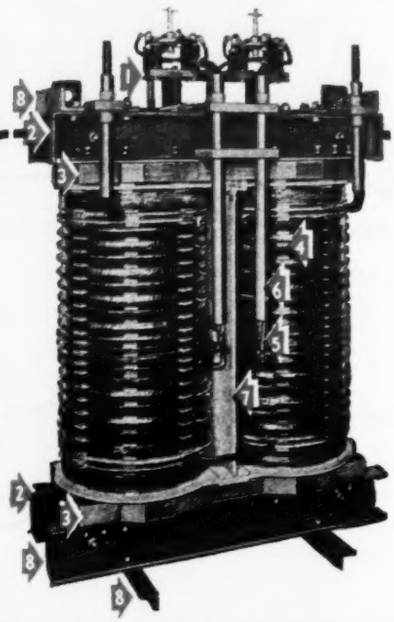
Single-Phase DISTRIBUTION TRANSFORMERS

provide a *plus* combination of superior characteristics . . .



Thousands of Wagner transformers are winning their "service stripes" under the heavy stress of present wartime loads. Wagner transformers have a fine reputation for being able to stand up in service—and there are many reasons, too many to list in the space limitations of a single advertising message.

The features listed below are but a few of many reasons why Wagner transformers stay on the job under the severe operating conditions to be encountered today.



1 Tap-changers are mounted on fully-seasoned, vacuum-dried, oil-treated maple supports—to provide high dielectric and mechanical strength with proper alignment.

2 Top and bottom endplates and associated parts are made up of fabricated structural steel forms rigidly bolted together. All nuts are locked in place by means of pal-nuts or other approved shakeproof devices.

3 Coil-clamps of oil-treated maple effectively clamp the coils and prevent distortion under operating conditions.

4 High-voltage single-division coils are separated from each other by insulating washers.

5 Taps are brought out in the middle of the winding where they offer no real problem as far as weakening coils and causing breakdowns.

6 Tap-leads are grouped together and carried thru insulating tubes to the terminal-board or tap-changer. This procedure mechanically supports the leads in the space necessary for proper electrical clearances.

7 Barriers of heavy pressboard between the two legs of the windings prevent flashover.

8 The element is securely braced against horizontal and vertical shifting. The lower clamping members are extended to the dimensions of the tank; the top members are anchored to the tank walls.

Low-voltage cylindrical-type coils are amply provided with oil-ducts passing through their entire length, assuring effective cooling throughout the winding. An insulating cylinder supplemented by an oil-duct on each side provides insulation between the high-voltage and the low-voltage coils.

TRANSFORMERS
are but one of several WAGNER PRODUCTS serving industry.

Other WAGNER PRODUCTS:

AIR BRAKES
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TACHOGRAPH (Recording Speedometer)
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ELECTRIC MOTORS

THESE 29 SALES AND SERVICE BRANCHES ARE READY TO SERVE YOU

For complete information on Wagner distribution transformers (or other types of Wagner transformers such as power, air-cooled, substation, rural-line, etc.) write to the address below or to the nearest of these 29 branches manned by trained field engineers who are ready to help you solve your transformer problems:

ATLANTA 3 • BALTIMORE 18 • BOSTON 15 • BUFFALO 8 • CHICAGO 16 • CINCINNATI 10
CLEVELAND 15 • DALLAS 1 • DENVER 2 • DETROIT 2 • HOUSTON 2 • INDIANAPOLIS 4
KANSAS CITY 8 • LOS ANGELES 15 • MEMPHIS 3 • MILWAUKEE 2 • MINNEAPOLIS 4
NEW YORK 7 • OMAHA 2 • PHILADELPHIA 8 • PITTSBURGH 13 • PORTLAND 9 • ST. LOUIS 3
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T45-6

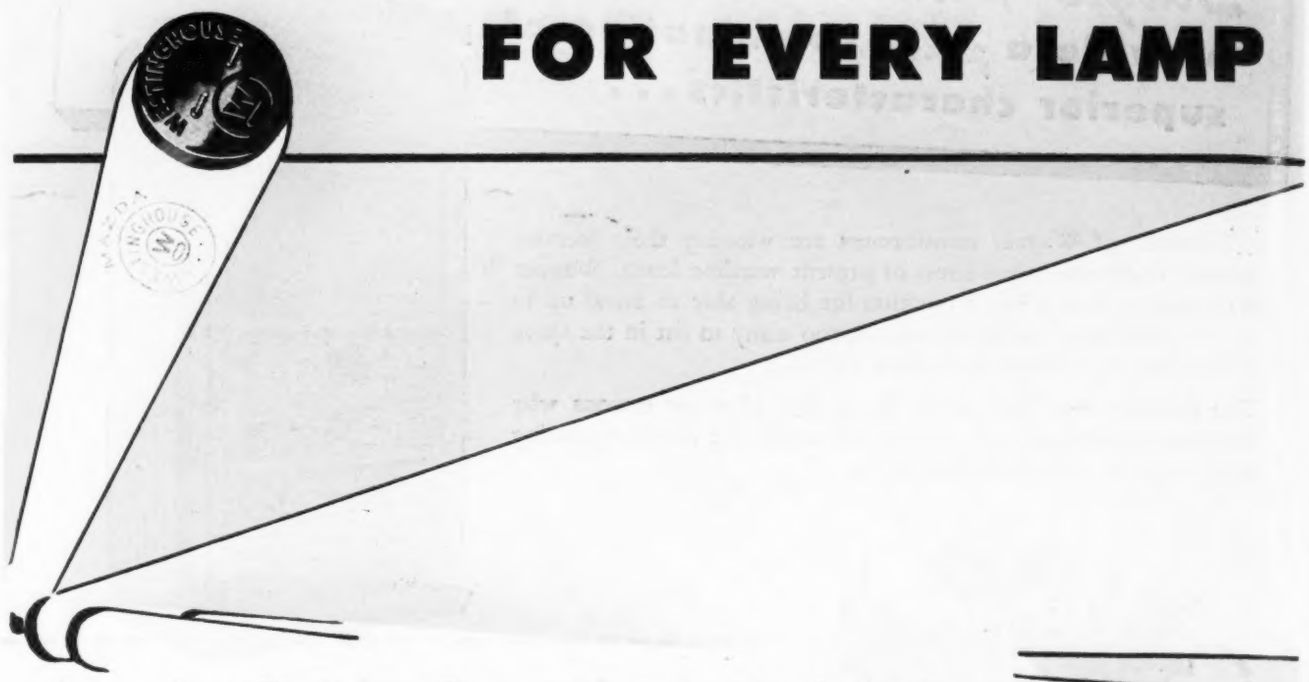
Wagner Electric Corporation

ESTABLISHED 1891

6456 Plymouth Avenue, St. Louis 14, Mo., U. S. A.

ELECTRICAL AND AUTOMOTIVE PRODUCTS

A LONG, BRIGHT FUTURE FOR EVERY LAMP



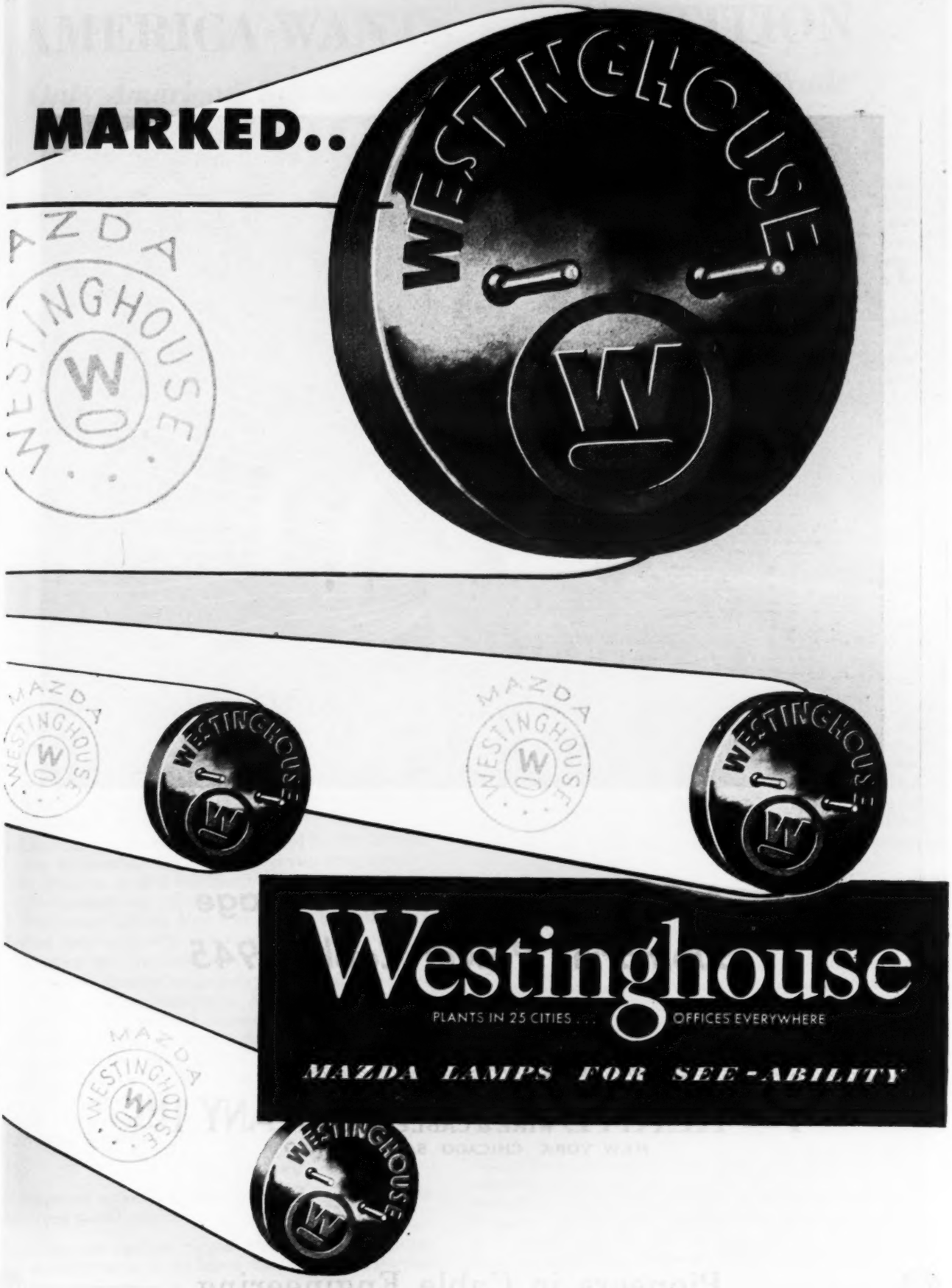
Every Westinghouse Fluorescent Lamp is a triumph of tireless research, skilled engineering and manufacturing know-how. Long life, unvarying efficiency and end-to-end brightness are literally built into every lamp carrying the famous Westinghouse trade mark.

Rigid control of raw products guarantees the utmost in quality material used. An example of this meticulous care can be demonstrated by the system of acid-washing, mixing and blending by which the phosphor powder is purified. Foreign matter is removed to a degree that not one part in a million remains to affect the light output.

This is matched by a precision of assembly technique which assures the uniformity of every Fluorescent Lamp Westinghouse makes. For instance, standards are so exact that no lamp varies more than 47/1000ths of an inch in length.

"Quality Control" means a long and useful life for every Westinghouse Fluorescent Lamp. And naturally means that you can recommend with complete confidence every lamp marked "Westinghouse." Westinghouse Electric & Manufacturing Co., Bloomfield, N. J.

MARKED..



Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

MAZDA LAMPS FOR SEE-ABILITY

Pioneers in Cable Engineering

Armoring Kerite High Voltage Submarine Power Cable, 1945

THE KERITE INSULATED WIRE & CABLE COMPANY INC
NEW YORK CHICAGO SAN FRANCISCO

Pioneers in Cable Engineering

AMERICA WANTS COMPETITION

Only American Initiative Can Preserve It in World Trade

AMERICANS generally agree upon what constitutes a desirable pattern of international economic relationships. We want an expanding world trade, with minimum recourse to government-imposed trade barriers and discriminatory trading arrangements, and offering ample scope for competitive private enterprise. Because they are necessary to such trade, we want also stability of exchange rates, and national currencies that are mutually convertible at least for the settlement of current accounts. We want, too, arrangements to facilitate long-term capital loans with security to the lender and advantage to the borrower.

Few other nations subscribe to these aims with enthusiastic conviction. Some reject them flatly as impractical under the conditions likely to prevail during the postwar period, or achievable only at prohibitive cost to their domestic economies.

Unless, therefore, we can formulate a practical and comprehensive program to carry out our aims, and convince other nations that we will take a sustained and responsible part in making it effective, the international trade of the world surely will be conducted under a system of exchange controls, bilateral agreements, cartel bargains, import quotas, and direct government purchasing arrangements that are the very antithesis of the competitive system that we favor.

To agree upon a concrete American **program,** and to convince other nations that it is to their advantage as well as ours to accept it, is a major task of economic statesmanship. It entails reversing a trend which has persisted since World War I, and which has been intensified during the depression years of the nineteen-thirties and by the exigencies of World War II.

Clearly, that is not a task to be assumed lightly. We can hope to be successful only if (1) we have a deep conviction that what we seek is fundamentally important to the American interest, and (2) if we will take pains to understand why other nations fear that such a program may jeopardize their interests, and then make whatever accommodations may be necessary to resolve their doubts.

An expansive foreign trade policy has been advocated so vigorously and repeatedly in America recently that The Economist (of London) comments wryly upon what it terms the ironic circumstance that "the acceptance of the principles of free trade by the more literate (American) public should come at a time when the doctrines in their simplest nineteenth-century form have been pretty generally emasculated in fact and repudiated in principle by the rest of the world".

☆ ☆ ☆

Why are we opposed to managed world trade, and for competitive world trade?

First, we are against rigged and managed international markets because we know that successful participation necessitates a comparable degree of control over the domestic economy as well. There is little debate of this fact, and those nations which accept a managed external trade as a necessary protective measure are generally willing to pay the price in internal regimentation. We are not. For us to do that would be as alien to our genius as it is repugnant to our conviction.

Second, we believe that the United States will be able to compete successfully in world markets, even though we have, and intend to maintain, wage scales far higher than those of the nations whose competition we must meet.

There is impressive evidence to substantiate the soundness of this conviction:

1. Wage scales, of themselves, do not determine the competitive position. They are meaningful only when translated into labor costs, by dividing wage rates by units produced. **A recent War Production Board study shows that in manufacturing industries generally, during the period immediately before the present war, production per man hour in the United States exceeded that in the United Kingdom, Germany and Soviet Russia by a ratio of more than 2½ to 1, and that of Japan by more than 4 to 1.** When comparison is made with available wage data, it appears that our labor costs are generally on a competitive plane.

2. Perhaps the best evidence of our ability to compete in export markets is the record of our demonstrated capacity to do so in the past. **During the entire period between World Wars I and II, the United States consistently commanded a greater share of the world's export trade than any other nation,** although the United Kingdom took a larger percentage of world imports.

3. We have been particularly successful in world trade competition in the export of machinery, vehicles, a variety of manufactured specialties, and certain agricultural products. Except in the last-named field, there is every evidence that we enjoy genuine competitive advantage over other nations, and this advantage will have been increased rather than diminished by developments during the Second World War. It is noteworthy that the goods in which we have been able to compete most successfully have generally been the products of our high wage industries rather than those in which low wages have prevailed.

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It is clear that, on a price basis, we shall be able to compete successfully in postwar markets in numerous lines. It is equally clear that such an opportunity is by no means of negligible importance to our own economy as a whole. During the years in which the censuses were taken between 1909 and 1939, our exports amounted

to from 7 to 16 per cent of our entire production of movable goods. **In the year 1938 our exports in each of the following lines accounted for more than 10 per cent of total domestic production of the particular product.**

(The figures in parenthesis are the percentages of total production exported.)

CRUDE MATERIALS: Phosphate rock (51.5), cotton (30.5), tobacco (29.4).

FOODSTUFFS AND BEVERAGES: Linseed (49.4), dried fruits (36.2), canned sardines (29.4), rice (21.0), fresh pears (15.9), canned salmon (13.8), canned asparagus (13.2), canned fruits (13.0), wheat (12.2), lard (11.7).

SEMI-MANUFACTURES AND FINISHED MANUFACTURES: Refined copper (53.1), paraffin wax (46.3), gum turpentine (42.6), carbon black (40.8), gum rosin (38.0), borax (35.9), crude sulphur (35.6), aircraft and parts (26.8), office appliances (22.3), carbons and electrodes (21.8), printing and bookbinding machinery (18.2), agricultural implements and machinery (17.0), biologic pharmaceuticals (15.3), industrial machinery (14.4), dental instruments and supplies (14.3), automobiles (14.1), benzol (13.3), goat and kid upper leather (12.8), refined lead (12.0), radio apparatus (11.8), caustic soda (11.4), refined mineral oils (10.6).

It is of major concern to all engaged in these lines of activity and in many others that foreign markets be not closed to us. It is particularly to our interest to have export outlets for our war-expanded capital goods and equipment industries. Since we undertook an important percentage of such expansion in order to furnish munitions to our Allies, it is reasonable to ask their cooperation in cushioning what inevitably must be a drastic readjustment here. The case is strengthened by the fact that the postwar world will desperately need the equipment items that we, alone, can supply.

But our demonstrated ability to compete on a price basis will not, of itself, assure us of foreign market outlets. Transportation costs, quality of product, marketing skill, technical and repair service—all are basically important. Still more important are non-discriminatory open markets and the command of dollar exchange by prospective purchasers. Our export potentials will surely be cramped in a world organized on the basis of bilateral deals and exchange controls. The availability of dollar exchange must depend upon the level of American imports and the volume of American capital loans.

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How are we to explain the skepticism of other nations toward an order which to us seems so clearly to represent not only our interest but the long-range interest of the world as well?

Soviet Russia, of course, is committed to conducting its external trade through its central government. But what of the United Kingdom? Why are there so many British voices that counsel the abandonment of what has been Britain's traditional position for more than a century? If we can understand that, we shall understand the dissent from our position of most nations whose economic positions have weakened and whose fiscal problems have multiplied during the two World Wars and the ill-starred period between them.

Essentially, their case is this:

Partly, they were forced into managed external trade policies by the Axis self-sufficiency programs, adopted in preparation for aggressive war. That can be corrected only by crushing the Axis, and by establishing a world security system that will make self-sufficiency a less compelling need.

But primarily, the reluctance of peaceably inclined nations to forego restrictive controls over postwar foreign trade stems from a deep-seated fear that is even more difficult to resolve. They fear, on the basis of past experience, that their efforts to meet payment balances arising from normal foreign trade would force a deflation of their internal economies, affecting prices, credit, wages and finally employment. Faced with the choice, as they see it, between making adjustments in foreign trade or in their domestic economies, they lean toward the former as, at worst, the lesser of two evils.

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Since the kind of world trade system we seek is dependent upon international arrangements to assure reasonable stability of exchange rates between national currencies, we are challenged to find a formula that both will provide this and at the same time allay what other nations believe are legitimate fears with respect to their domestic economies.

But at least two major steps toward resolving such doubts can be taken upon our own initiative without recourse to the intricate process of international negotiation.

One is the rational overhauling of our tariff system, to provide other nations with increased opportunity to export to us. We can, and should, do this in a way that avoids undue cost to any segment of our economy.

The other, and probably the greatest contribution we can make toward winning a reluctant world to our point of view, will be to offer ample and convincing evidence that we are ready and able to provide a high level of employment in the United States. If we can do that, the rest of the world will wish to expose itself to our influence rather than to insulate against it, since prosperity here is the greatest single contributing factor to world-wide prosperity.

Balance of payment problems are minimized in a world of thriving trade. Britain would have little reason to resort to exchange controls if the total of postwar world imports and exports reaches an 80 billion dollar level. She may well be in a desperate plight if it should revert to the 1935 level of 40 billions.

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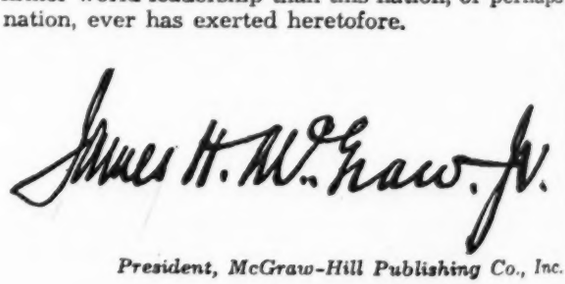
The United States wants a world in which private enterprise and competition play a major role. To obtain such a world will require a wiser, more understanding and firmer world leadership than this nation, or perhaps any nation, ever has exerted heretofore.



President, McGraw-Hill Publishing Co., Inc.

Electrical World

MARCH 3, 1945

G. I. Education

THE G. I. BILL OF RIGHTS will be our greatest experiment in mass education for peaceful pursuits. While conceived as an aid to the veteran it can just as easily be a liability. It depends so much upon the manner in which we maintain the integrity of our educational requirements.

Educators fairly generally insist that while there might be some relaxing of entrance requirements for veterans there should be no lowering of passing requirements. The only question is whether they will be able to maintain that position or will succumb to pressure that they be lenient with the boys.

These young service men are not going to be satisfied with an easy two or three years, because most of them will realize that they have already lost some very valuable time and will have to be competing with youngsters coming up behind them. They are going to college to prepare for an occupation and, unless we are entirely wrong, they will not want to lose much time.

For that reason the veteran crop of undergratuates should be a very serious lot and much more demanding of their professors than a normal group of college boys. If there are several men in a class who cannot keep up with the pace, we believe it will be found that the class will refuse to be slowed down. What to do with the slow ones is going to be a problem.

To be lenient with men who haven't the capacity to learn isn't the answer. In fact, such leniency might spoil what would otherwise be a good mechanic.

After these men are graduated they have to face the hardest test of all—a job. Because they are veterans they will have little trouble getting a job, but holding it or advancing is something else. That is when the quality of the education will show up. That is when the veteran to whom leniency was shown in his post-service education will discover that what appeared to be kindness was in reality a disservice.

Employers are not going to be able to upgrade men who haven't the qualifications, yet if it is found that servicemen who had the G. I. education are not getting ahead as fast as others there is bound to be an unfavorable reaction against the employers. Moreover, when these men come out of the universities industry and business will be expected to absorb all who want to go that way. And business and industry will be found eager to do their part in helping these fellows to get started. Are business and industry going to have to do the weeding out that should have been done in the colleges?

It seems to us that now is the time for employer groups and educator groups to explore the matter together. Industry needs these men as soon as it can get them but not badly enough to want them with a half-baked education.

We shall be dealing with the future lives of men who fought for their country. Let us be sure that this great experiment with their future works to their advantage. Let education and business together work out now as many of the bugs as they can foresee. It is too much of a responsibility for either to assume alone.

High Frequency Heating and the Power Sales Engineer

Importance of analyzing working conditions of heating apparatus before selecting equipment for industrial applications—Methods of determining frequencies and other elements of the problem of securing optimum results in this fast-developing field

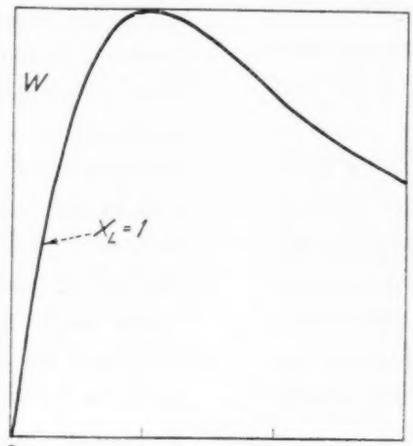
L. M. DURYEE, Connecticut Light & Power Co., Waterbury, Conn.*

THE UTILITY has a greater stake in the development of high frequency heating than any other group connected with it. The market for the sale of industrial power by means of this kind of heating after the war will present an excellent opportunity for the power sales engineer to replace lost business, as war production ends, with new industrial loads on a relatively large scale. Such an opportunity entails definite responsibilities. The power engineer must prepare himself at the earliest possible moment to take the leadership: (1) in analyzing industrial applications, (2) in recommending suitable equipment to his customers, and (3) in following up these installations to insure that every device in the plants in his area efficiently and economically performs the jobs for which it is suited. In short, he must become a proficient consultant of recognized ability in the field of induction and dielectric heating if he is properly to develop this important post-war market.

Much has been written on the subject of high frequency heating. Few if any authors, however, have approached the field from the specific viewpoint of the power sales engineer. It is therefore timely to review the fundamentals involved; to establish a sound approach for equipment selection; and to stimulate thinking so that the necessary leadership of power sales engineers will be even more firmly established. We must prepare ourselves now because the post-war era may be upon us sooner than we think. High frequency heating equipment may shortly be released for peace-time industrial uses.

Fundamental Theory

When an electric current passes through any material it overcomes resistance and the energy thus used is converted into heat. The power so



CURVE SHOWING that maximum power is obtainable from a heating unit only when the values of reactance and resistance are equal

used is represented in the familiar equation

$$W = I^2R \qquad (1)$$

In any given circuit, R, the resistance is a fixed quantity at a given temperature. Therefore the only way to increase W, the power, is to increase I, the current. In an a.c. circuit,

$$I = \frac{E}{Z} \qquad (2)$$

in which E is the applied voltage and Z is the impedance. The equation for power thus becomes

$$W = \frac{E^2R}{Z^2} \qquad (3)$$

According to this equation, W, which is the producer of heat, is maximum when E is as large and Z is as small as they can be. For obvious reasons E must be taken as a fixed quantity in any practicable heating circuit. Consequently, the way to attain maximum W is to give Z its lowest possible value. But Z is not a simple quantity, easy to adjust. Its equation is

$$Z = \sqrt{R^2 + X^2} \qquad (4)$$

in which X is the reactance of the circuit. Equation (3) thus becomes by substitution

$$W = \frac{E^2R}{R^2 + X^2} \qquad (5)$$

For an induction heating circuit, X is inductive reactance and is designated X_L. Equation (5) thus becomes

$$W = \frac{E^2R}{R^2 + X_L^2} \qquad (6)$$

As may be seen from the accompanying graph X_L has an optional value of equality with R at which W is maximum.

In the graph, equation (6) is plotted against W and R and X_L taken as unity and E as any constant. The curve rises and falls; its highest point is where R equals one. X_L also equals one. Therefore the circuit absorbs most power when resistance and in-

* Industrial power engineer.

ductive reactance are equal quantities, that is, when the power factor is 0.707.

Inductive reactance, X_L is a function of applied frequency according to the equation

$$X_L = 2\pi f L \qquad (7)$$

in which f is frequency and L is inductance in henries. Since the optimum value of X_L is equality with R, then the frequency required to provide that value is

$$f = \frac{R}{2\pi L} \qquad (8)$$

From the foregoing mathematics comes the conclusion that for most effective inductive heating there is one frequency for a given piece of work. As will appear later in this article, equation (8) is developed into practical formulas in terms of dimensions and properties of work to be heated.

Range of Commercial Apparatus

Commercially, equipments available for frequency heating fall in three general classifications, as follows:

(1) Motor generator sets—from 180 to 9,600 cycles

(2) Spark gap oscillators—from 50,000 to 300,000 cycles

(3) Vacuum tube oscillators—300,000 to 30,000,000 cycles.

It is to be noted that the m-g sets (Group 1) operate with relatively high power factor, efficiencies of 70-75 percent; balanced three-phase loads; and are obtainable in almost any size. They are low in maintenance cost. Spark-gap oscillators (Group 2) are built up to 20 kw. of output in size, are approximately 50 percent efficient; present a single phase load; and frequencies are unstable unless gaps are properly maintained. The vacuum tube oscillators (Group 3) are balanced three-phase loads; 95 percent power factor; approximately 50 percent efficient; and are extremely stable both in frequency and power output throughout the life of the tubes.

Frequency Selection

Let us assume that a manufacturer of bolts is now heading them by the cold-heading process. With this method, his completed bolts must be annealed for stress-relieving, which entails an unnecessary and costly handling operation that will be eliminated by preheating. Moreover, hot-heading will materially lengthen die life of the heading machine. The smallest diameter of bolt is, for purposes of illustration, one inch.

A convenient formula has been developed, based upon the fundamental concept outlined above, as follows:

$$f = \frac{P\,10^7}{u\,r^2}$$

where f = frequency in cycles per second
r = radius of work in inches
P = resistivity of work in ohms/cm.^{3}
u = permeability

Thus, in the example selected:

r = 0.5 in.
u = 1 (because heating for forging is above the Curie point of 1,420 deg. F. at which steel loses its permeability)
P = 140 micro. ohms/cm.^{3} at 1,600 deg. F.

Then the optimum frequency for heating these 1-in. bolts for forging is:

$$f = \frac{140 \times 10^{-6} \times 10^7}{(0.5)^2} = 5{,}600 \text{ cycles/sec.}$$

A standard motor-generator of 9,600 cycles would do this work satisfactorily. If, however, we were to preheat $\frac{1}{8}$-in. diameter bolts for heading, then frequency would be

$$f = \frac{140 \times 10^{-6} \times 10^7}{(.06)^2} = 400{,}000 \text{ cycles,}$$

which would necessarily be handled by a vacuum tube oscillator of approximately 500,000 cycles.

The kilowatt rating of the oscillator would be determined by:

$$\text{Kw.} = \frac{17.6 \times \text{Sp. heat} \times \text{temp. rise}}{1000} \times \text{lb./min.}$$

It is seen that frequency selection, while it can not be exact in every case, can be arrived at for all practical purposes, depending upon the general classification in which the work falls, compared to the commercial equipments available.

The problem, when surface heating is involved, is not possible of solution by the above method because the heating band is cylindrical, rather than solid in cross-section.

Thus, the "effective depth of penetration" method should be used, as follows:

$$D = 1{,}400\sqrt{\frac{P}{uf}}$$

where D = inches of penetration of the eddy-currents
P = resistivity in ohms/cm.^{3}
u = permeability
f = frequency in cycles/sec.

An example of this problem is illustrated by the hardening of bearing pins 2½-in. long, ½-in. in diameter, to 60 Rockwell "C", with a penetration depth of only 0.025 in.

A vacuum tube oscillator producing 5 megacycles was selected for this job, because a lower frequency would have induced too deep a hardened area, making a distortionless heat treat much more difficult to obtain. Precise control of extremely thin case depths is possible with megacycle energy from 1-15 mc., even though these oscillators operate at reduced efficiency due to I^2R circuit losses, (which increase with the higher frequencies.)

Choice of Supply Method

In one factory a major item of production was a steel tube of 2-in. outside diameter. It required three heating operations for brazing sleeves to the tubes. The other operations in this factory consisted of thin surface hardening of small shafts, spur and bevel gears. These smaller parts could not be heated efficiently with motor-generator frequencies, but the 2-in. steel tube job was a border-line case between an m-g set and vacuum tube oscillator. The selection which was made for this plant was, quite properly, a 500,000-cycle electronic oscillator the operation of which has been most successful.

In recommending induction equipment for industrial heating of metals, the power engineer must establish in his own mind the approximate frequency required based upon these important fundamentals, and upon many actual applications. If this is not done, induction heat cannot successfully compete with other processes. Then, prior to final recommendations, actual tests of the customer's product must be performed by the power salesman, so that the details of inductor-coil coupling, size of oscillator, heating timecycles, plate voltage, ampere-turns of inductor, product fixture design, and the many other problems can be worked out. The power engineer thus becomes, in reality, the customer's consultant, co-operating with high-frequency equipment manufacturers, so that a complete machine-tool for heating will be delivered to the industrial plant, complete with handling mechanisms, ready for immediate use, and suited to the specific needs at hand.

In the important field of dielectric heating—the heating of non-conducting materials—it is equally imperative that the power engineer know his fundamentals, because here as in any new process the customer is confused by a myriad of claims. A simple concept of what takes place when a substance is made to act as the dielectric between the two electrodes of a radio-frequency condenser is submitted as a practical description of "dielectric heating". It is sufficiently accurate (and at the same time non-technical) to be useful to anyone interested in visualizing the phenomenon of electronic heating of non-conducting materials.

Fundamentals of Dielectric Heating

Each atom of the substance is composed of a positive nucleus around which revolve (negative) electrons, in fixed orbits, the number of orbits dependent upon the atomic structure of the substance. As a high-voltage, high-frequency field is applied to these atoms, between the electrodes, the orbits of electron travel are severely stressed. As this stressing takes place with extremely large frequencies (in the order of 20 to 30 million times each second) molecular friction is set up. Since molecular friction always results in heat generation, then the whole mass of the substance becomes uniformly heated from within (provided the dielectric losses throughout the substance are uniform). Except for surface radiation (which can be prevented by proper insulating materials surrounding the substance) we can count upon this heating method to produce uniform heat in uniform-loss substances entirely from within the mass. This heat generated in the material follows the following fundamental law:

$$\text{Heat generated} = K \times P.F. \times D.C. \times E^2/t^2 \times f.$$

where E = applied voltage
t = thickness
$D.C.$ = Dielectric constant
$P.F.$ = Power factor at the given frequency
f = cycles/sec.

It is seen that since heat varies as E^2, then the first requirement for rapid heating is a high voltage gradient between electrodes. Since 10 to 15 kv. is the practical maximum from vacuum tube oscillators before flash-over occurs (and only vacuum tube equipments can produce ultra-high frequencies) then it follows that as high a *frequency* as possible is usually recommended. This varies between 10 and 30 megacycles from practical present day oscillators. These are capable of producing power in quantities up to 25, 50, or 100 kw., or even higher, if desired.

Future Applications

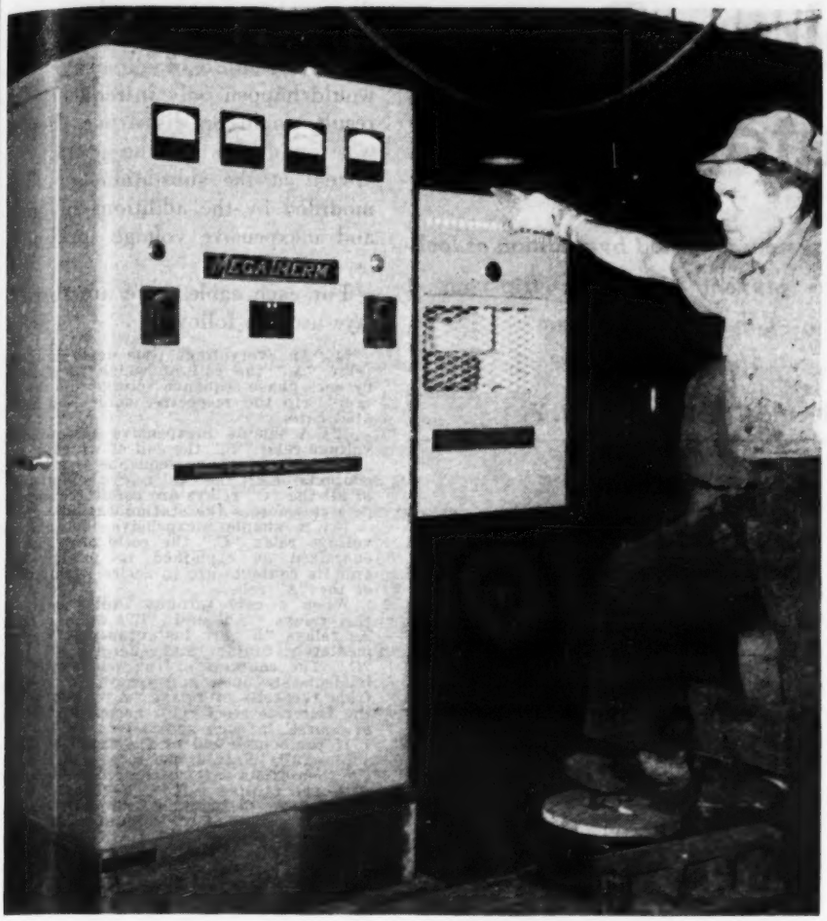
Among applications of dielectric heating which can be most economically justified in the immediate future for speeding manufacturing processes, are: (1) the much publicized plastic molding, which produces from 200 to 300 percent decrease in curing time; (2) the bonding of plywood; (3) the cementing of numerous products requiring a critical control of external (surface) temperature; (4) the curing of resin-impregnated textiles (rayon, nylon, cotton, etc.); (5) the dielectric curing of rubber in all its phases; (6) shoe manufacturing; (7) the curing of cable insulation; (8) the baking of ink in printing processes both in paper and textile mills; (9) the drying and baking of ceramics; and perhaps at a later date the baking of bread in commercial and institutional bakeries. A newly developed process which illustrates the versatility of dielectric heat is the repairing of automobile and truck tires, where the electrodes of a radio-frequency oscillator are placed around the external break in the tire, and the diverted dielectric field penetrates the rubber to the fabric and vulcanizes uniformly in 15 min. while the tire remains on the wheel.

Fresh Bread Again

Such wide fields exist for the development of the dielectric heating market that it is difficult to visualize the ultimate outcome. Hundreds of new applications are in the offing. As an example, the writer recently bought a dozen week-old rolls from a bake-shop, which were extremely stale, hard, and unpalatable. Inserted, still in their wax paper wrapper, between the electrodes of a 15-megacycle oscillator in a nearby molded plastic plant, the rolls were completely "rehabilitated" in three seconds. They emerged as fresh as the day they were baked! Is it not possible that properly

HIGH FREQUENCY HEATING enables tires to be repaired at rapid rates in comparison with former methods of vulcanizing.

A 2-kw. Raytheon dielectric heating unit (patented by Lt. Col. C. W. Vogt, chief technical staff for Supply, Transportation Corp., Washington, D. C., and developed with the aid of Eino Lakso, Fitchburg, Mass.) is shown, operating at 37 megacycles. Tires remain on wheels while surface breaks are vulcanized. Steam curing equipment with molds and tanks weighs 6 tons per unit, requires 1.5 hr. for curing and gives temperature variations of 12 to 50 deg. F. High frequency units weigh but a fraction of the above, complete tire repairs in 15 min. and maintain far more uniform heating. These are specially valuable in battle areas and on aircraft carriers. The use of bags full of pulverized material (sand) between electrodes (in curing bullet or other holes through the tire) provides ready adjustment to variations in tire shape and thickness at shoulders, side walls and treads, make possible sectional cures in a few minutes with minimum temperature difference, and maintains properly sharp shoulder edges to correspond with edges of the tire adjacent to areas of cure.



3-KW. 15-MEGACYCLE dielectric heater preheats plastic "preforms" on one-third the former time; used for uniform heating of 6-lb. charges for compression molding

prepared bread dough conveyed through parallel electrodes will be ultimately baked on a large scale with undreamed of speed, uniformity and even a satisfactory economy? And a radiant heat lamp bank will put on the crust. While the present efficiency of converting from 60-cycle to high frequencies is not now in favor as to B.t.u. economy in the field of bread baking, it is possible and even probable that tube development will increase this efficiency sufficiently so that dielectric bread baking will be promising purely from a B.t.u. standpoint. The long time cycle now imposed by the limitation of surface temperatures is eliminated with high frequency equipment. Floor space, a large item of cost with present convection ovens, will be reduced to only a few square feet, with high-speed, perfectly controlled high-frequency baking.

Our responsibility as power sales engineers lies in obtaining the facts of each prospective application; in conscientiously applying these facts; and, lastly, in maintaining an open mind to the many possible processes that can be developed. We need also to influence the high-frequency equipment manufacturers to substitute industrial heating terms for their present radio engineering technology and electronic vernacular. We don't want to scare away the practical-minded plant engineer. We need to present to our industrial prospect, not a radio "gadget", but a complete heating process engineered for tough industrial use, ready to give years of uninterrupted service in industry. And in doing this we must keep constantly in mind that the overall cost of the finished product rather than mere B.t.u. cost is the customer's ultimate measure of the success of any heating process.

Power Companies Should Lead

A thorough, careful, detailed analysis of the customer's product; proper studies of available equipment to fit the need; and a firm conviction that we, more than anyone else, can completely do the job from an unbiased viewpoint, are going to pay the power industry high dividends. The field of frequency heating in all its phases presents a most promising tool for localized heating, or for mass heating, in almost every industry. Power companies have a greater stake in the proper development of this miraculous heating tool than any others connected with it.

This is *our* job. Let us develop this market before us with enthusiasm and confidence.

18,000 LB. OF RAYON CONES per day pass through this 27-megacycle dielectric field between parallel electrodes. The process permanently sets the rayon cords. High frequency power output of the unit is 15 kw.

Lockout Relays Deter Possible Outages

Ground relay system modified by addition of lockout relays to prevent substation trip out if breaker fails to clear cable fault

A. R. CURRY, Buffalo Niagara Electric Corp., Buffalo, N. Y.*

IN BUFFALO, New York, there are about thirty, 60-cycle automatic distribution substations which receive power over 22-kv. cables and step it down to 4 kv. (see Fig. 1). In these substations there is no 22-kv. bus and each of the 22-kv. cables is connected to its individual step-down transformer bank, which is delta-connected on the 22-kv. side.

The 22-kv. cable system is, therefore, grounded only at the generating station, where there is a 5-ohm neutral resistor. This means that when there is a wire-to-ground fault, the zero phase sequence current flows only

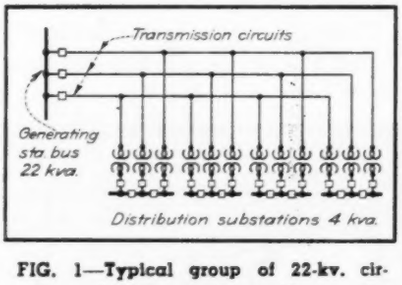


FIG. 1—Typical group of 22-kv. circuits and 4-kv. substations (System described by R. T. Henry in *Electrical World*, July 25, 1931)

in the faulted cable and only from the source station to the fault.

The faulted cable is cleared at the source and by means of overcurrent relays in the residual circuit of the current transformers. In order to clear the cable at the substation it is necessary to resort to zero sequence voltage. As originally designed, at the substations, a three-phase potential transformer was connected on each incoming cable. These potential transformers were connected grounded-wye, broken-delta, so as to provide zero sequence voltage to an overvoltage time delay induction relay, each for tripping its associated 22-kv. cable and bank. In case of a ground fault on a cable, all the overvoltage relays at the substations would start to run. When the faulted cable was cleared at its source end, zero sequence voltage would exist only on the faulted cable, so at the substations all the overvoltage relays, except those on the faulted cable, would reset, but those on the faulted cable would continue to run and at a predetermined time would clear the cable.

That would normally give satisfactory clearing of cable ground faults, but it was soon recognized that, if for any reason, the faulted cable failed to clear properly at the source end, all the overvoltage relays at all substations would continue to run until they contacted and caused a complete loss of power at all substations.

Though failure of a breaker to clear would happen only infrequently, the result would be disastrous. Remedy was found by which the ground relay system at the substations could be modified by the additions of simple and inexpensive voltage lockout relays. See Fig. 2.

For each cable there are three relays used as follows:

(1) An overvoltage time delay induction relay "A," the coil of which is energized by zero phase sequence voltage and its contacts trip the respective cable and associated bank.

(2) A simple inexpensive instantaneous voltage relay "B," the coil of which is energized by zero phase sequence voltage. The contacts of all the "B" relays and the coils of all the "C" relays are connected together in series across the station battery.

(3) A simple inexpensive instantaneous voltage relay "C," the coils of which are energized as explained in paragraph 2, and its contacts are in series with the coil of the "A" relay.

When a cable ground fault occurs, all the relays "A" and "B" are energized. As relays "B" are instantaneous, they immediately contact and energize all relays "C." The contacts of the relays "C" then immediately open and remove the voltage from the coils of relays "A," thus causing the latter to reset. This action takes place, of course, in each substation.

If the source end of the faulted cable is successfully cleared, the zero sequence voltage then exists only on the relays associated with the faulted cable. The other "B" relays become deenergized and their contacts open the circuit of the coils of relays C and the contacts of relays "C" close and complete the circuits of the "A" relays.

The "A" relays on the faulted cable are then again energized and in a predetermined time their contacts close and initiate tripping to clear the faulted cable at each substation.

If for any reason, the source end of the faulted cable should fail to clear, the relays "A" and "B" continue to lockout any tripping at the substations, and the system continues with a ground fault until the operator at the source station can clear the fault by hand.

Breaker auxiliary "b" switches are installed across the contacts of the "B" relays, as otherwise the lockout scheme would be inoperative whenever one cable breaker was out of service.

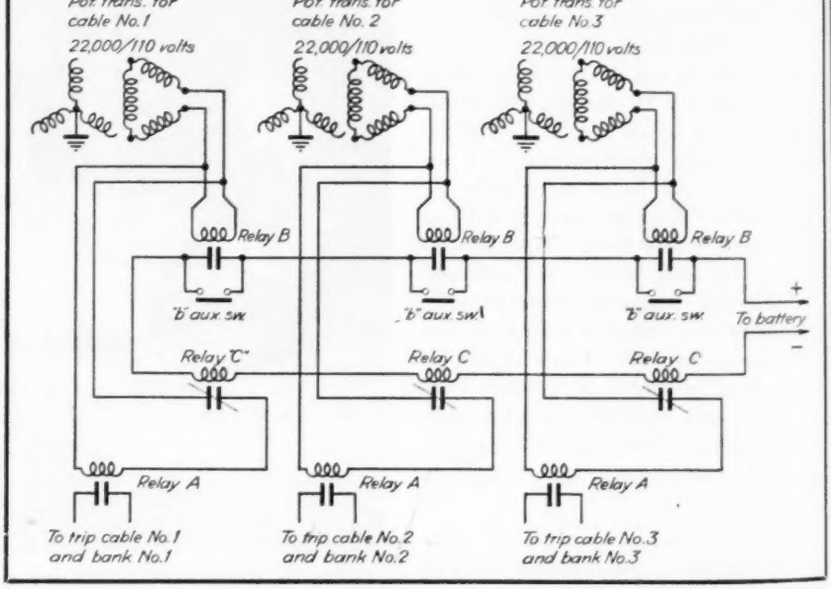


FIG. 2—Lockout scheme at typical distribution substation in conjunction with relaying for 22-kv. ground faults

* Engineering Department.

Condensers Halve Cost Per Kw. Transmitted

Nearly 50 percent reduction in annual charges per kilowatt transmissible over 115-kv. line with corrective condensers—Additional system capacity released by generating kilovars near load

K. B. ALDRICH and WILLARD JOHNSON, Bonneville Power Administration, Portland, Ore.*

ANALYSIS of the cost of delivering kilovars along with kilowatts has been made in connection with the Bonneville Power Administration lines toward encouraging the BPA customers to generate their own reac-

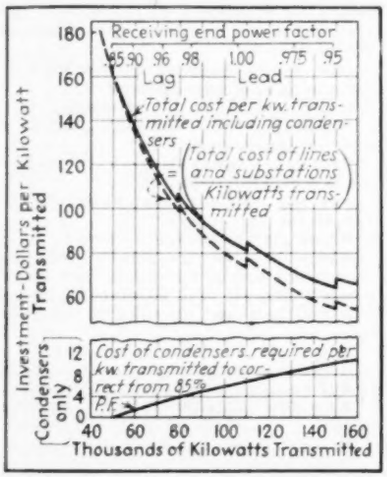

Receiving end power factor
.85 .90 .96 .98 1.00 .975 .95
Lag
Lead
Total cost per kw. transmitted including condensers
Total cost of lines and substations
Kilowatts transmitted
Investment-Dollars per Kilowatt Transmitted
Condensers only
Cost of condensers required per kw transmitted to correct from 85% P.F.
Thousands of Kilowatts Transmitted

FIG. 1—Unit costs of transmitted power over typical 230-kv., 200-mile line (including transformers). Voltage drop held constant at 11 percent by power factor correction to unity; customer load power factor taken as 85 percent in determining requisite synchronous condenser capacity

tive requirements rather than have them delivered over the 115 or 230-kv. lines. This study naturally brought out the familiar facts (1) that transmission of reactive limits the kilowatt capability of a line and (2) that the kilovars should be generated near the load in order to release the maximum capability of the system, promote economy of investment and conserve critical materials.

Charge for Reactive Kilovars

A further conclusion is that there is benefit to both utility and customer in rate schedules based on separate charges for the reactive kilovars rather than on limitation of power factor by bonus and penalty provisions. The study indicates that the annual charge per kilowatt can almost be halved by use of capacitors in amount sufficient to bring an 85 percent power factor load of 24,000 kw. to unity power factor at the load end of a 115-kv. line. For the same ten percent voltage drop the line can carry 68,500 kw. and thus dilute the annual charges despite the addition of the capacitor investment.

One calculated example was based on a 230-kv. line 200 miles long with transformers at both ends. Computations were made for both 11 percent voltage drop (Fig. 1) and 5 percent voltage drop (Fig. 2).

Capacitors on 115 Kv.

A second computation was made for a typical 115 kv.-line with its receiving-end transformer and here the voltage drop assumed was 10 percent. In this instance the cost saving per kilowatt (Fig. 3) is not as large, in comparison with the condenser cost, as in the case of 220 kv. but the economy is still very worth while and is to be considered.

Assume that 24,000 kw. is being transmitted at 85 percent power factor; the per-kilowatt investment in line and substation is seen to be $47. If it is decided to install synchronous condensers to correct to unity power factor as indicated on the curve, 68,500 kilowatts can be transmitted with the same voltage drop. But to raise the power factor to unity, one must install $6.70 worth of condensers per kilowatt transmitted.

Original cost of line and transformers $47 x 24,000	=$1,128,000
Synchronous condensers to be installed $6.70 x 68,000	= 459,000
Total....	1,587,000

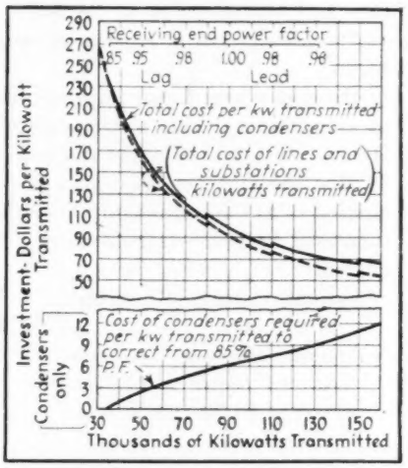

Receiving end power factor
.85 .95 .98 1.00 .98 .98
Lag
Lead
Total cost per kw transmitted including condensers
Total cost of lines and substations kilowatts transmitted
Investment-Dollars per Kilowatt Transmitted
Condensers only
Cost of condensers required per kw transmitted to correct from 85% P.F.
Thousands of Kilowatts Transmitted

FIG. 2—Unit cost of transmitted power over typical 230-kv., 200-mile line (including transformers). Voltage drop held constant at 5 percent

With 68,500 kilowatts transmitted, the unit cost reduces to:

* Senior Electrical Engineer and Electrical Engineer, respectively

$$\frac{\$1{,}587{,}000}{68{,}500} = \$23 \text{ per kilowatt,}$$

with the power factor at the receiving end of 85 percent.

On the basis of annual charges for interest, amortization, sinking fund, operation and maintenance, there is assumed 11 percent for synchronous condensers and 8 percent for transmission line and substation.

Third Example

For the transmission of 24,000 kw. at 85 percent power factor, Fig. 3 shows the investment per kilowatt in

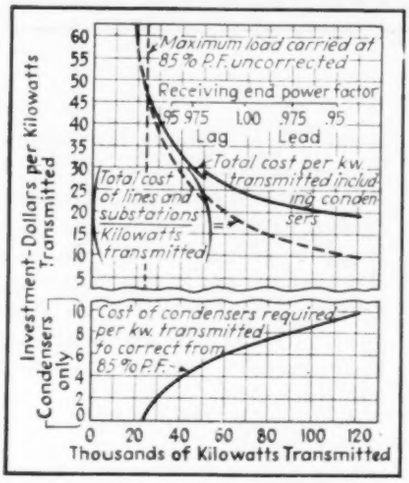

Investment-Dollars per Kilowatts Transmitted
Maximum load carried at 85% P.F. uncorrected
Receiving end power factor
.95 .975 1.00 .975 .95
Lag
Lead
Total cost per kw. transmitted including condensers
Total cost of lines and substations
Kilowatts transmitted
Condensers only
Cost of condensers required per kw. transmitted to correct from 85% P.F.
Thousands of Kilowatts Transmitted

FIG. 3—Unit cost of transmitted power over 50-mile 115-kv. line with receiving transformers. Voltage drop held constant at 10 percent by power factor correction

line and transformers to be $47

Annual charges at 8 percent equal $3.86

Through power factor improvement to unity, we are able to transmit 68,500 kw. It should be noted (from Fig. 3) that the cost per kilowatt has decreased to $17.50 (this figure includes increased power transformers required.)

Annual charges 8 percent of $17.50 = ...	$1.40
Annual charges on condenser require—11 percent of $6.70 (taken from curve) = ...	.74
Total annual charge per kilowatt = ...	2.14

By the installation of condensers and increased transformer capacity, we are able to reduce the annual charges per kilowatt from $3.86 to $2.14, which is a reduction of 45 percent.

Real Results from Home-Made Survey

By GEORGE KERR
Ebasco Services, Inc., New York, N. Y.

The president of an electric company said "I would not have believed what I see here before me if it had not been written by men and women right in our own company!"

He had responses to his personal letter to every one in his organization. Here it is:

"Although we feel our electric service is maintained on a high plane, we are continually seeking means whereby it may be improved.

"Our employees *are* the company and their contact with the public is the index by which the company is judged. We have no reason to doubt the constant, courteous and considerate treatment accorded the public by our employees. But, on the other hand, we realize that you meet with all manner of questions regarding the company which you should be enabled to answer readily, definitely and clearly. We wish you to be properly equipped in this respect.

"Will you please let us have a list of such questions as you may be able to recall? Use both sides of this sheet if necessary and send it to me signed or unsigned as you desire."

Here are a number of the questions that came in. But before you read them, there is a point in the president's letter which is fraught with significance. In ancient days the messenger who brought bad news to the king usually had his head chopped off for his trouble. Employees are extremely reticent about telling the higher-ups anything derogatory about the business, fearing to be connected with anything which may tend to deflate management's ego. So this astute president mentioned that the replies could be *signed or not* as the writer desired. Another consequential inconsequentiality: There was enclosed a stamped envelope addressed to the president. The replies:

Who set the rates and how?
Why are rates so high?
Why don't we have TVA rates?
Why do I have to pay more for lights in my store than in my house?
Rate reductions last 10 years?
List of rates local municipal ownership towns?
How much would it reduce rates to cut in half salaries of president and high executives?
Do you reduce rates voluntarily or do they make you?
Couldn't rates be reduced if company had less stocks and bonds issued?
Is the company guaranteed sufficient revenue to meet all operating costs including taxes and a fair rate of return on investment?
If the company's revenue should be greater than the amount needed to meet operating costs, including a fair rate of return, would the company automatically have to reduce rates?
Rates are high because of watered stock; big salaries to executives; write-ups; company spent money extravagantly building plants and lines; fees paid to holding companies; too many employees in the company; company does not try to pay off its debt.
Why don't you have a flat rate like 'phone company?
Why do the "big fellows" have the lowest rate?
Why does the amount used determine rate per kw.-hr.?
Why the minimum charge?
Why doesn't company "pay out" its debt?
Is there a sinking fund for the bonds?
If not, why not?
Which is paid first—interest on bonds or dividend on stock and why?
Aren't dividends "profit"?
Common stock dividend record?
Preferred stock dividend record?
How many preferred stockholders?
How many preferred stockholders locally?
Present price of preferred and bonds?
Why can't you pass bond interest the same as you pass stock dividends?
Percent of company's capital requirements supplied by sale of bonds, preferred stock, common stock?
What significance, if any, to have outside accounting concern certify financial statements?
To what governmental bodies does company render financial reports?
Is surplus cash in the bank?
What is meant by the company's "investment in fixed capital"?
Why does the company have to borrow money for extensions, additions, etc., to the system instead of using the earnings of the business?
How can a company borrow on a note when it cannot pay dividends?
What is meant by a "write-up"?
Where may the company's bonds and stock be purchased?
Can the company issue more stock and bonds whenever it pleases?
Are the company's securities listed on any of the "exchanges"?
Where may quotations be seen?
Where does the money come from to pay for present property additions and improvements? We are told earnings do not provide for them and no stock or bonds seem to be sold.
Is it right for the company to make contributions to various charities at the expense of customers and stockholders?
Why was I cut off when I owned stock on which the company owed dividends?
Contributions to local charities, etc.?
"How much money does company take in in a year and what do they do with it all?"
Can man in power plant cause meters to run faster?
Each time "black spot" appears how many kw.-hr. are used?
Does a customer have any way of testing his meter to determine amount used?
Are our lines connected with any other utility?
Number of miles of lines?
Why does company threaten to cut off my service when bill is less than my deposit?
In case of break-down do we have any other source of supply?
What is used for fuel and can any other be used with present equipment?
Isn't water-power cheap power?
Sections covered by company's rural lines?
Can't my bills for service be charged against unpaid dividends on stock I own?
What is scope of jurisdiction of Federal Power Commission and other commissions having regulatory power over the company (including city councils or other local bodies)?
What is a kilowatt-hour?

Movable Hoist For Network Transformers

Demountable frame on casters devised to handle heavy transformers where vaults are located where headroom or operating space is scant

J. F. MILLER, Louisville Gas & Electric Co., Louisville, Ky.*

SEVERAL YEARS AGO in developing the Louisville, Ky., a.c. network we were faced with handling transformers that were heavier than any previously used in our vaults. They were 300-kva. three-phase, oil-filled units and weighed about three tons. The job of lowering these units into place was complicated by the location of some vaults in narrow alleys and under theatre marquees with limited head room.

A hoist that would handle such a load within these space restrictions was difficult to find. Visits to other utilities revealed that their equipment was too large, awkward and expensive. Also, the hoists they used required an extra trip or an extra vehicle to deliver it to the job.

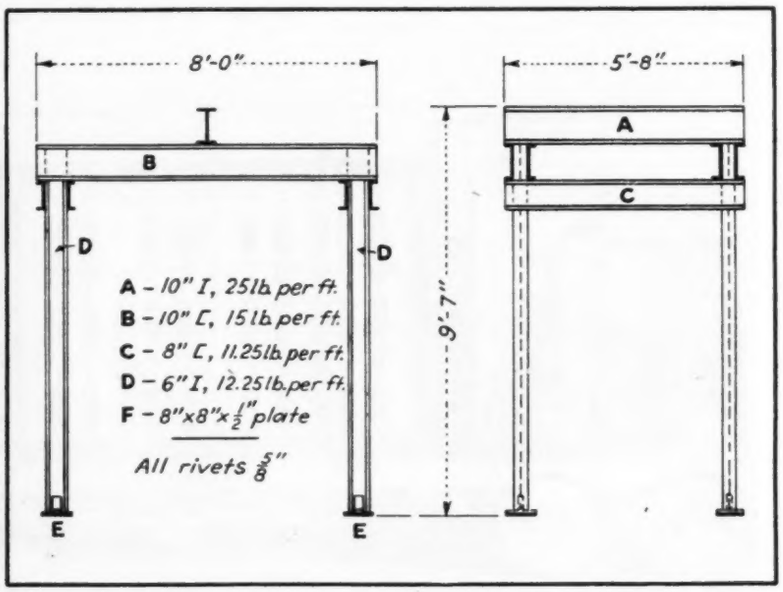
To satisfy our needs the network transformer hoist, shown, was finally designed and built in the company shops. The hoist is a Wright special low-head trolley type No. 600 with a capacity of 12,000 lb. It has an 18-ft. lift and the hook ascends to within 8 in. of the I beam upon which the hoist travels. This is important as it keeps the center of gravity low. Arrangement of the hoist frame is illustrated. To make the hoist and frame easily movable so it can be centered over the hatch, the frame is mounted on Bond 10A7 semi-steel casters. These have a 7-in. diameter, 3-in. face and $\frac{3}{4}$-in. axle with ball bearings in the turn table.

The hoist was used in this manner for several years. More recently, however, some 500-kva., three-phase, Pyranol-filled transformers were acquired. To handle these the hoist was strengthened by adding removable horizontal braces between all four legs just above the caster plates. These braces consist of 3-in. I beams with a flat hook extension on each end to mate with strap loops on the vertical legs. The braces hold the legs much in the manner that side rails of a bed hold the head and foot with the frame braced in this manner the 500-kva. units were handled with ease.

This hoist, the transformer, a portable unloading ramp, cribbing, and other rigging are loaded together on a low-bed trailer and delivered to the job in one trip. The ramp is placed, the hoist is pushed down it using the truck winch line as a holding line. Next the hoist picks up the concrete slab hatch cover, weighing about 2,000 lb., and carries it out of the way. Then when the transformer has been spotted over the open hatch on cribbing, using the bar and roller method, the hoist frame is wheeled into place and picks it up. Cribbing is removed, as the illustration shows, and the transformer may be lowered by one man since the hoist has a very high gear ratio.

Although the equipment might appear to be top heavy it is not. It requires very little storage space, can be used in very narrow alleys, has low head clearance but sufficient to lift its load above the necessary cribbing. Last but by no means least, it costs less than $600 to produce.

* Superintendent Electric Distribution Dept.



HOISTING FRAME IN USE (left) placing a 300-kva. network transformer. Steel assembly (right) for frame; casters not shown. Removable horizontal braces (not shown) are hooked between legs of the frame when handling extra heavy loads

Portable Rectifiers for Dry Docked Ships

Trailer-mounted 200-amp. ignitrons provide service from 2,400-volt, 60-cycle circuit to ships' d.c. auxiliaries—Optional connections provided to meet variety of d.c. circuit requirements

C. P. HAMILTON, General Electric Co., Schenectady, N. Y.*

SHIPS IN DRY DOCKS for cleaning or repairs cannot develop power on board, hence power for operating machinery and lights must come from shore. Because most yards and docks have only a.c. power and many ships are fitted for direct current, conversion is necessary. Two portable rectifiers recently furnished for converting 500 kw. alternating current to direct current by means of sealed ignitrons have already served several famous ships.

Circuits

Many ships require 3-wire, 250/125-volt service though some can use only 125 volts. The rectifiers shown in Fig. 2 are arranged to provide optional circuits as shown in Fig. 3 to meet a variety of requirements. It should be noted that rectifier A has its transformer primaries delta-connected while those in rectifier B are wye-connected.

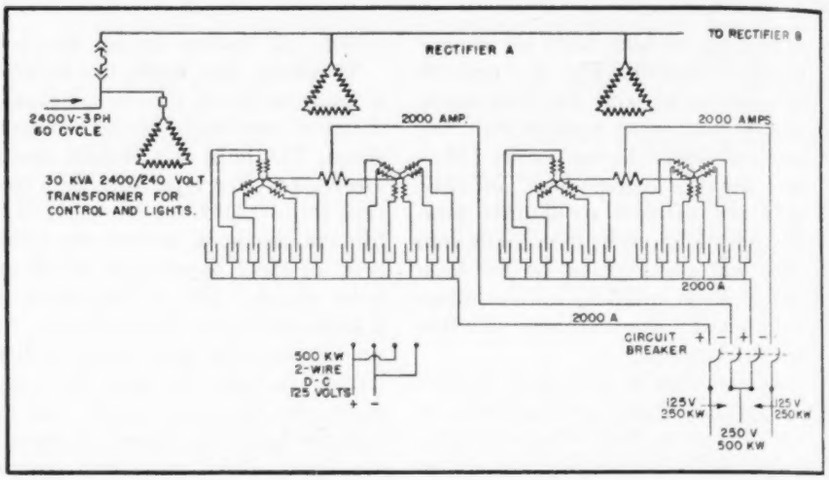


FIG. 1—Connections in rectifier A for delta primary quadruple wye. Note from Fig. 3 that rectifier B transformer primaries are wye connected

Rectifier A is connected as shown in Fig. 1. Each rectifier as shown in this diagram consists of two 250-kw., 125-volt units connected in series for 3-wire, 250/125-volt service. Thus full

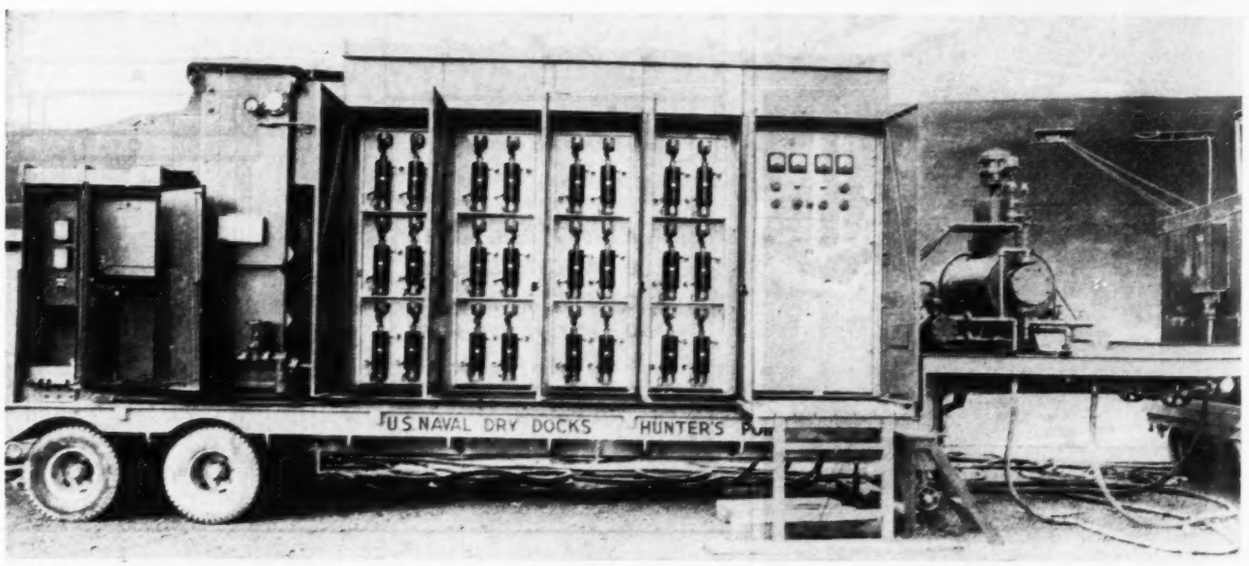


FIG. 2—One of two 500-kw. portable rectifiers furnished for serving ships in drydock

* Machinery Manufacturers Section, Industrial Engineering Division

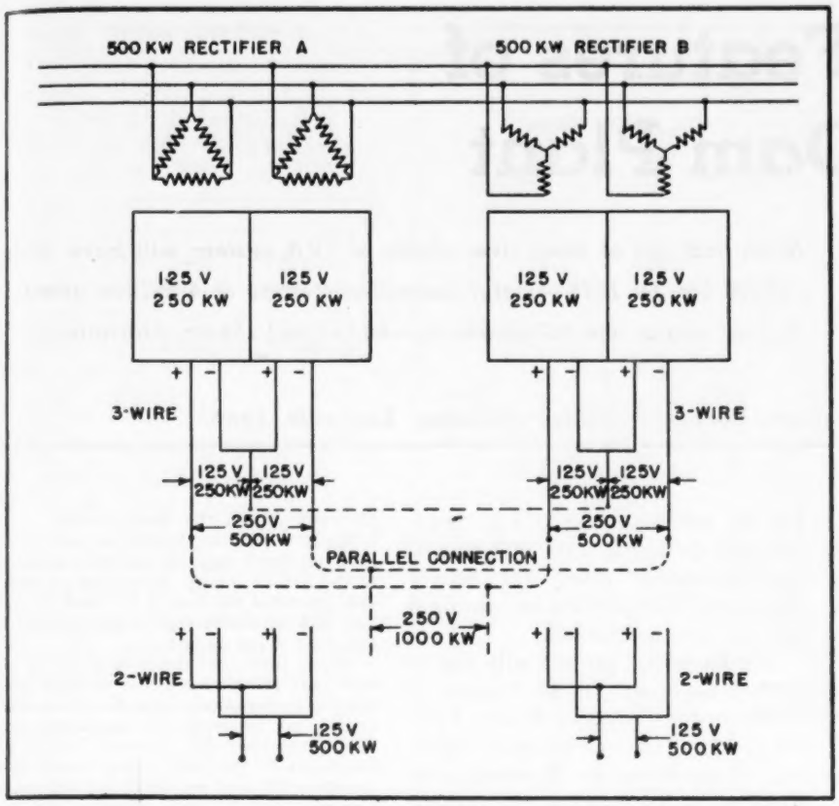


FIG. 3—Optional circuits provided by the two 500-kw. portable rectifiers for operating ships' auxiliaries designed for 125 volts and 250 volts

rated current output can be obtained from either line to neutral for 125-volt operation or the two units can be connected in multiple if sustained loads of more than 2,000 amp. are to be carried at 125-volts. Rectifier B has similar connections.

The rectifiers and transformers are cooled by salt water received under pressure from the dock pumps. Distilled water from the rectifiers is circulated through a heat exchanger by a vertical pump, motor-driven, at right in Fig. 2. Pyranol* from the transformer is cooled in another heat exchanger, circulation being maintained by a horizontal, motor-driven, close-coupled pump. The circulation systems are shown in Fig. 4.

Assembly

Each rectifier is assembled on a 25-ton trailer furnished by the purchaser. The deck is 25 ft. long by 8 ft. wide and the total load is about 20 tons. Additional area on the gooseneck provides room for part of the cooling system and for storing cable, hose, platform and steps between jobs. Screw jacks are used to support and level the gooseneck end of the trailer.

A number of stations are provided about the docks where the rectifiers can be plugged into the 2,400-volt circuit. Other stands have been installed to take the d.c. output cables and provide connections for shore to ship cables.

Incoming a.c. line cable is attached to the compartment by means of a 200-amp. special disconnecting device. Cables from the d.c. distribution stands are bolted directly to the bus bars in the d.c. end. Bus bars are provided for the parallel connection shown in dash lines in Fig. 3 for optional circuits.

These connection provisions make it possible to move the rectifiers from one location to another with little loss of time.

Details

Each rectifier is rated 500-kw., 250/125-volt, 3-wire, or 125-volt, 2-wire, 2,000/4,000 amp., 125 percent load for two hours, 200 percent load for one minute. Each consists of the following units:

(1) 2,400-volt, 3-phase, 60-cycle incoming line compartment with a 50,000 kva, interrupting rating, 600-amp., circuit breaker.

(2) Control transformer compartment.

(3) 630-kva., 60-cycle, 2,400-volt primary to 128-volt line to neutral, forced Pyranol-cooled transformer.

(4) Rectifier units with mounting for twenty-four (24) 200-amp. ignitrons.

(5) Direct-current control unit with an electrically operated 4-pole, 2,500-amp. air circuit-breaker.

(6) Two heat exchangers, one for the rectifier distilled water and the other for the transformer Pyranol or coolant.

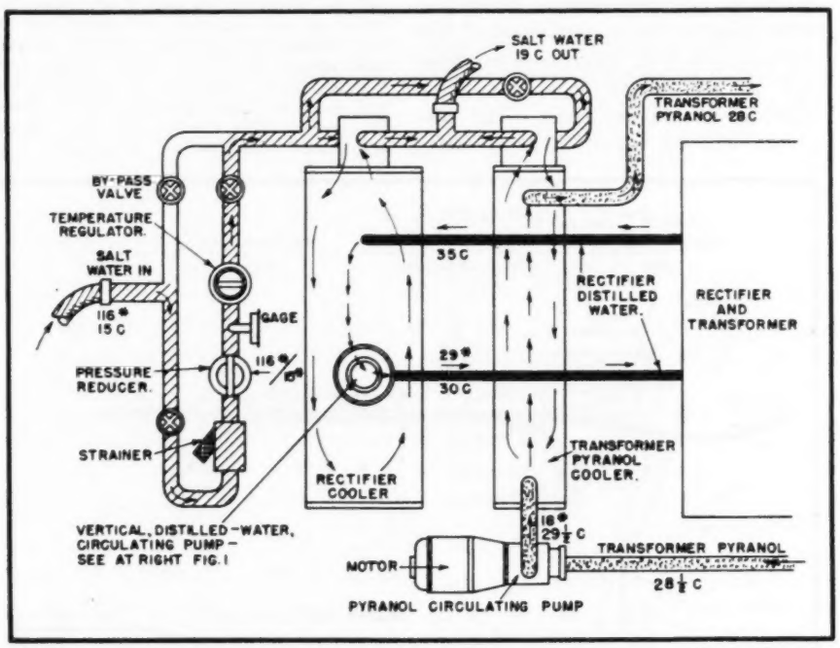


FIG. 4—Circulation of salt water, distilled rectifier cooling water, and transformer Pyranol in the heat transfer system on each rectifier

* Registered, U.S. Patent Office.

Electrical Features of Kentucky Dam Plant

Ninth and last of main river plants of TVA system will have added 128,000 kw. by 1945—Useful controlled storage of 4 million acre-ft.—Annual output one billion kw.-hr.—66-kv. and 154-kv. transmission

R. E. BEHNKE, Head Design Engineer, Tennessee Valley Authority, Knoxville, Tenn.

KENTUCKY PROJECT, located about 22 miles above the mouth of the Tennessee River, is the last of the nine main-river plants to be constructed and placed in operation as a part of the unified Tennessee Valley development program.

During the 6-year construction period at the Kentucky project, about 6,700,000 cu. yd. of earth and rock was excavated; about 1,400,000 cu. yd. of concrete was placed for the lock, dam, powerhouse, and switchyard structures; and about 5,000,000 cu. yd. of fill was placed for the earth embankments.

Initial operation began during August, 1944, when the gates were closed for starting the storage of water released by the upstream plants and the run-off from the Kentucky Reservoir drainage area. When the water reaches the normal level of the reservoir, a 9-ft. navigable channel will be established from the Ohio River to Knoxville, Tenn. The reservoir will be about 184-mi. long, and its volume at the 375-ft. elevation will be about 6,100,000 acre-ft. The generating plant will deliver about 1,000,000,000 kw.-hr. during a year of average rainfall.

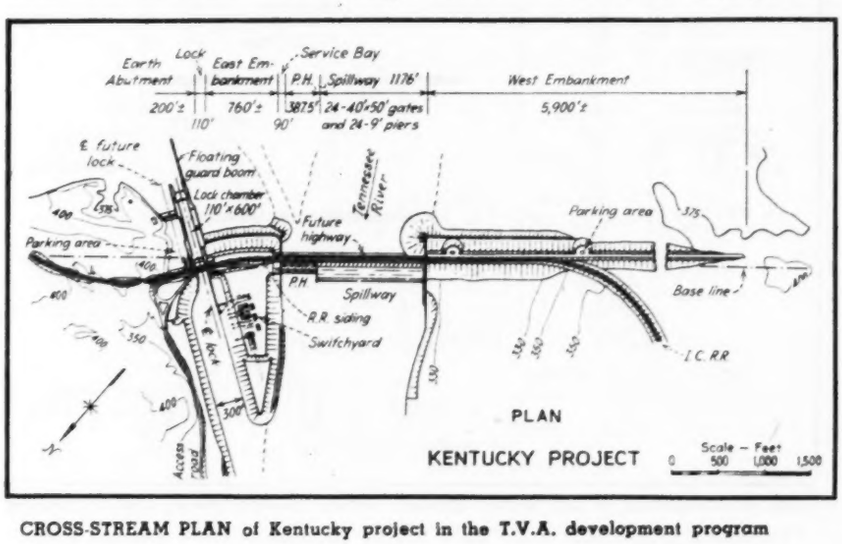
The Kentucky project will play a predominant part in the control of floods on the Tennessee River. Present plans for the multipurpose operation of the Kentucky Reservoir contemplate using the storage space between elevations 354 and 375 in varying degree during the annual cycle as follows:

During the flood season between January 1 and April 1, the water will be held at the 354 level, then filled as much as may be desirable but not above elevation 375, in regulating floods, and then drawn down again to 354 level. This reserves 4,100,000 acre-ft. of storage for flood control during the major flood season.

Between April 1 and May 1, the water will be gradually raised to elevation 359 where it will be held for about two to four weeks for malaria control. Beginning about May 15 or June 1, the level will be lowered gradually, for malaria control, so as to reach elevation 354 by about October 1. The release will add 730,000 acre-ft. of water to the discharges from upstream during the 4-mo. period.

Between October 1 and January 1, the reservoir level may be operated anywhere in the 354-359 range, depending on stream flow, provided the level is returned to elevation 354 by January 1 in preparation for the next flood season.

At any time after the flood season is over each year (about April 1 or perhaps later) temporary deviations from the levels stated above may be made in regulating small floods, provided that between June 1 and November 30 the level is not raised above elevation 365 and provided that during the malaria control season, between say June 1 and October 1, the normal level is restored within about 10 days. Thus a storage volume of not less than 1,000,000 acre-ft. is provided for control of floods during the summer.



CROSS-STREAM PLAN of Kentucky project in the T.V.A. development program

Powerhouse

Powerhouse structure is of the semioutdoor type, specially adapted to accommodate high tailwater conditions. The generators are housed in a continuous unobstructed operating space with governors and governor actuator control boards located between the units along the operating aisle. Individual hatches are provided over each generating unit and over each of the two erection areas at the service bays. A 250-ton gantry crane is provided for handling heavy equipment and for operating intake and draft tube gates. It is arranged to handle equipment directly from the cars on the railroad siding upstream of the service bays. The service bays with machine shop are located upstream at the east end of the powerhouse.

Offices, public reception rooms, control switchboards, terminal boards, and storage batteries are located adjacent to the service bays downstream. The offices, control room, and lobby are air-conditioned. The control room ceiling is acoustically treated and arched to give maximum light con-

centration on the switchboards from indirect lighting fixtures mounted in a specially designed cove on the operator's side of the room.

The electrical bay, with exciter and neutral cubicles, low-tension equipment structures, station service transformers, auxiliary power switchboards, control cable trays, CO_2 equipment, and main generator leads, is located on the downstream side of the powerhouse adjacent to the generator room.

Generators

Each generator is rated 35,000 kva., 0.9 power factor, 60 deg. C. rise, 13,800 volts, 3 phase, 60 cycles, 78.3 rpm. Continuous output of each generator at rated power factor, voltage, and speed is 40,250 kva., 80 deg. C. rise. These ratings match the turbine output when operating between the normal and maximum head range. The continuous output of each machine when operating as a synchronous condenser is 19,200 kva. and, when charging a transmission line, 28,000 kva.

Since the turbine runners are submerged below the normal tailwater level, a water depressing system has been installed so that the runners revolve in air while the unit operates as a synchronous condenser. The kilowatt input to the generators while motoring is reduced about 75 percent under that required when the blades revolve in water. The time required with manual control to change from generator to condenser operation is less than one minute, and with automatic control the change from condenser to generator operation is less than ten seconds.

Each generator was designed to meet the mechanical characteristics of 72,000,000-lb.-ft.^{2} flywheel effect, 220-rpm. runaway speed and a total thrust of 2,050,000 lb., including hydraulic thrust, and turbine and generator rotating parts.

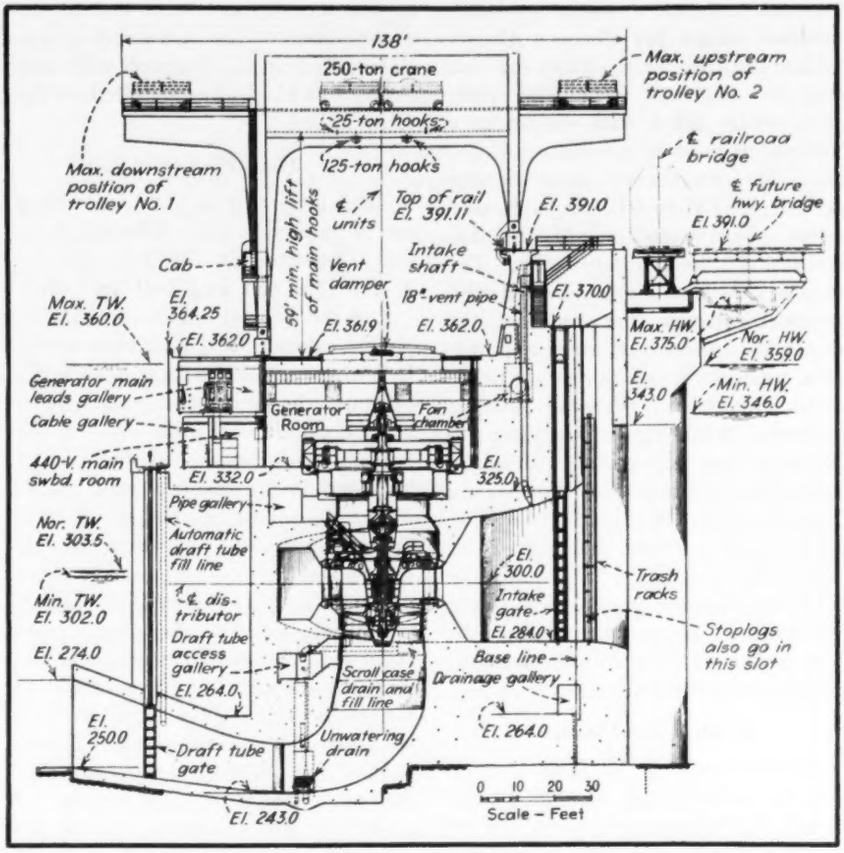
Main and pilot exciters are mounted above each rotor. Each main exciter is rated 240 kw. 40 deg. C., and 270 kw., 50 deg. C., 250 volts, and each pilot exciter is rated 15 kw., 250 volts. Overspeed device and oil head are mounted above exciters.

Bearing Supports

A combined Kingsbury-type thrust bearing and lower guide bearing are located below the rotor in a common oil housing supported on two 7-ft. girders that span the turbine pit. Side arm braces are connected to these girders with an articulated type of construction which mitigates twisting reaction on main girders when these girders deflect vertically from hydraulic thrust loading. An upper guide bearing is located above the rotor. The rotor and stator are enclosed in a common housing. The rotor action circulates the air out of the periphery of the stator through the coolers and back into the top and bottom of the rotor. Piping and nozzles are installed inside of the housing for automatic CO_2 fire protection.

Rotors are provided with discontinuous damper windings to improve the stability of the generator under fault conditions and specifically to reduce voltage distortion under single-phase fault conditions. The short-circuit ratio is 1.1.

In view of the difficulties encountered in obtaining forgings for shafts requiring large-diameter flanges at the turbine coupling end, a 2-piece shaft was supplied. The upper section is of standard diameter required by the unit and the lower section, which forms the upper cover of the turbine blade operating cylinder, is of special design with coupling flanges 89 in. in diameter.



SECTION THROUGH POWER HOUSE AND INTAKE of Kentucky Dam plant

Exciter, Grounding, Protection

A 2-panel exciter cubicle is provided for each unit with main exciter field rheostat, shunting contactors, relays, field breaker and discharge resistor; and with pilot exciter instruments and field rheostat. The main exciter field rheostat is arranged for remote control from the main switchboard either manually or by high-speed voltage regulator.

Grounding equipment for each unit consists of an oil circuit breaker, disconnecting switch, and 0.75-ohm current-limiting reactor enclosed in a steel cubicle.

Main generator oil circuit breakers, disconnecting switches, instrument transformers, surge protection equipment, and main cable terminals are enclosed in steel housings with Transite barriers. The main transformer leads are designed to carry 1,470 amp. per phase continuously and 1,690 amp. per phase at 75 percent load factor. The leads consist of two 1,500,000-cir. mil. 4-segment

compact strand, paper-insulated, shielded cables per phase. All six cables for the three phases of one unit are enclosed in a steel pipe, 8⅝-in. O.D., filled with oil under a continuous normal pressure of 200 psi. The lengths of these circuits vary from 725 to 910 ft., with stop joints about one-third of the distances from the generator ends. The ends of the circuits are provided with spreader fittings that separate the single steel pipe into three nonmagnetic pipes with two cables per phase that terminate in a porcelain pothead bushing. A small pumping plant and piping system is provided with necessary relief and automatic flow valves that limit the flow of oil at the stop joints in the event that major oil leaks should develop. This type of cable installation was selected to keep the copper requirements and the cross-sectional area of the space occupied to a minimum.

Control Equipment

Arrangement of the main control system includes the control benchboard, the instrument board, the relay board, the recorder board, the d.c. board, and the operator's desk in the center of the control room.

The benchboard is located in front of the operator's desk on which are mounted all the necessary controls required for the operation of major equipment. Instrument and relay panels are mounted back to back with the instrument panels next to the benchboard and facing the operator's desk. Indicating instruments, voltage regulators, transformer position indicators, and necessary test blocks are mounted on the instrument board. Relays and an oscillograph with necessary test blocks are mounted on the relay board.

Fault Protection

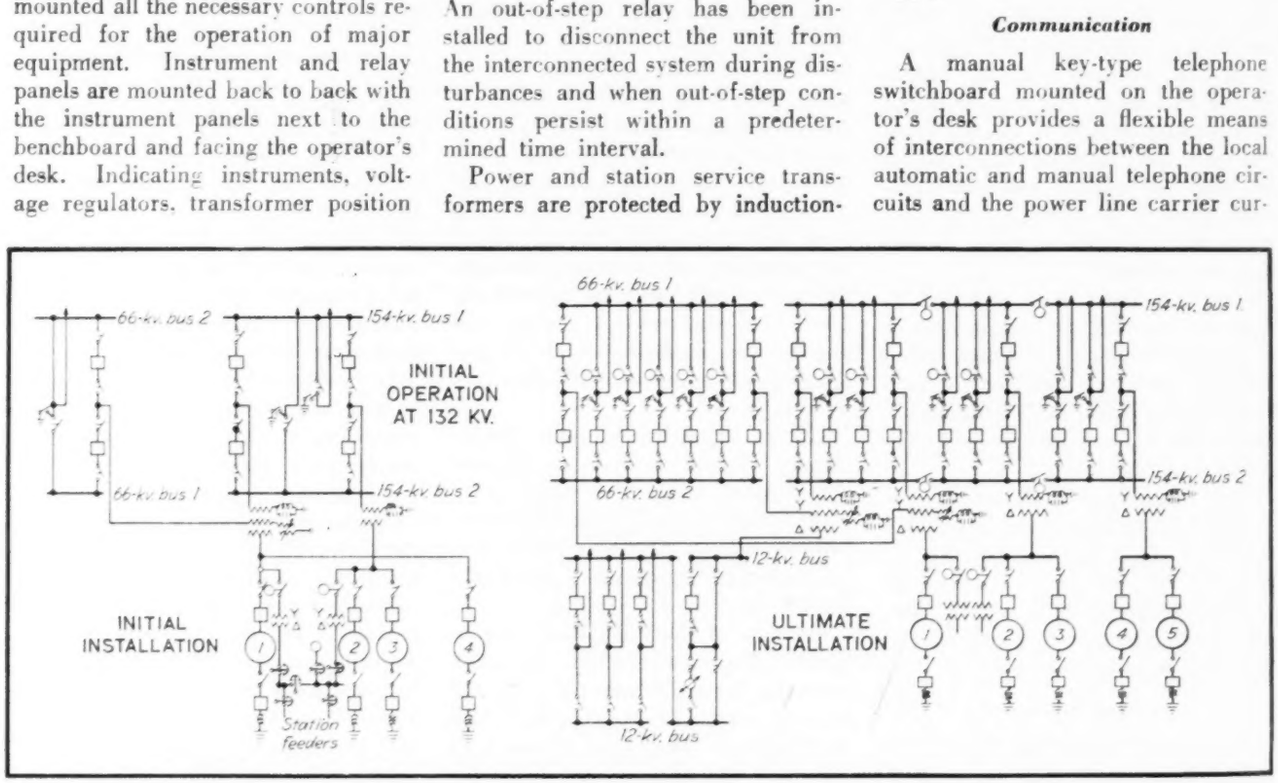
Each generator is provided with a set of induction-type differential relays connected in the full winding at the line end and half the winding at the neutral end to operate on phase, ground, and coil turn faults. It is also provided with a low-energy overcurrent relay connected as a ground differential relay between the current transformer in the ground lead and the residual current circuit of the phase current transformers to operate on ground faults near the neutral end of the windings and to serve also as a back-up for the phase differential relays. An overvoltage relay is provided to introduce automatically a block of additional resistance in the main exciter field circuit in case the generator voltage exceeds 110 percent of normal during runaway conditions. Similarly, a d.c. relay is provided and connected across the pilot exciter leads to automatically introduce a block of additional resistance in the pilot exciter field circuit in case the pilot exciter voltage exceeds 120 percent of normal. An out-of-step relay has been installed to disconnect the unit from the interconnected system during disturbances and when out-of-step conditions persist within a predetermined time interval.

Power and station service transformers are protected by induction-type, percentage-differential current relays. Induction-type overcurrent relays are also connected in the low-voltage windings of all banks and also in the high-voltage winding of the 3-winding bank. Distance relays are installed for the 66- and the 154-kv. lines with directional ground back-up relays. Provisions have been made for carrier current supervision when the high-tension lines are changed over from 132- to 154-kv. operation.

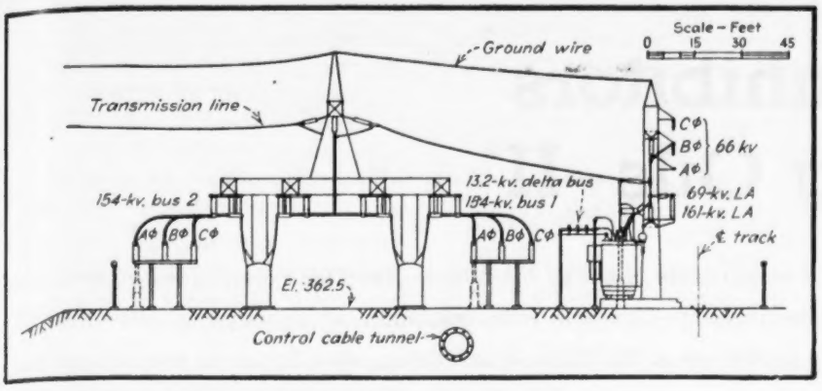
The recorder board, located at the left of the operator's desk, contains the automatic load-frequency control equipment and recording instruments for station and tie-line loads, station frequency, high-tension voltages, and generator and transformer temperatures. At the right of the operator's desk is a d.c. board with the 250-volt station control storage battery, d.c. feeders, and the 115-volt, 60-cycle preferred service controls. A 9.4-kva. motor-generator set with a d.c. motor operated from the 250-volt storage battery is provided with necessary automatic starting and standard frequency controls to supply emergency 115-volt, 60-cycle service for clocks, recorders, and carrier current communication equipment in the event of loss of the normal station service supply.

Communication

A manual key-type telephone switchboard mounted on the operator's desk provides a flexible means of interconnections between the local automatic and manual telephone circuits and the power line carrier cur-



SINGLE-LINE DIAGRAM showing initial and ultimate generator and bus connections



CROSS-SECTION THROUGH SWITCHYARD near powerhouse

rent telephone circuits. An annunciating and operating recorder is located on each side of the turret. This recorder ennunciates and records on a chart all starting, stopping, and testing operations, thereby automatically logging the station operations by printing the symbol designation of the equipment operated as well as the time at which the operation occurred. The recordings for each operation are made in about three seconds. If numerous operations occur simultaneously, the operations are automatically stored and then recorded at 3-second intervals. In addition to the recording operation, any abnormal conditions that require adjustments so as to avoid interruptions to service are indicated by illuminated windows at the operator's desk or at the governor actuator control boards.

Terminal boards are located in a separate room under the main control room. The wires from the controls and instruments are brought down through troughs and terminate at the terminal board and connect to cables that pass through the floor below to open Transite trays in a tunnel that extends along the electrical bay to the powerhouse equipment and to the switchyard. The control cables are carried on trays to points opposite the equipment to be controlled and then through conduit to the equipment and its connections.

Station Service

Station service is supplied by two 1,250-kva., 480-volt, 3-phase transformer banks, with one connected to the main generator leads of Unit 1 and the other to Unit 2. One 400-kva., 480-volt, 0.8 power factor gasoline-engine-driven generator set is provided to supply emergency service to essential auxiliary equipment and to emergency lighting circuits when all other sources to the station service system have been interrupted.

Main auxiliary switchboard has its bus divided in two sections, with one feeder from each bus section delivering power to the unit boards, a common distribution board, the crane trolley plug outlets, the lock operating control board, and the station main lighting transformers. A double throw switch is installed at each distribution point to prevent paralleling of main bus sections. One feeder from each bus section delivers power to two 125-hp. unwatering pump motors. The main supply and bus tie breakers are electrically interlocked to prevent parallel operation of transformers and of the engine-driven generator with either transformer. A unit distribution board serves all essential auxiliaries required for that generating unit. A common board distributes power to the auxiliaries necessary for general station operations and the air-conditioning control board.

Switchyard

The switchyard is located on an island formed by the lock and the main river channels adjacent to the powerhouse downstream. The structures are designed for 66- and 154-kv. operations. Line traps, capacitors, and potential devices are provided for all 154-kv. lines. The connections branch off through disconnecting switches and breakers to buses mounted on separate supports on either side of the main structure.

Three 3-winding single-phase transformers form bank 1 with a bank rating of 45,000 kva. self-cooled, 60,000 kva. forced air cooled, 161/132-66-13.2 kv. The 66-kv. winding is provided with electrically operated remote-controlled tap changing under load equipment. This bank with above rating was selected to transform the output from one generating unit to the 66- and 154-kv. systems. Since the installation of the fifth generating unit was deferred, forced-oil coolers are being added to increase the bank rating to enable this bank to carry temporarily the output of two generating units. Generator No. 4 will be connected to this bank until the fifth generator is installed. Three 2-winding single-phase transformers form bank 2 with bank rating of 63,000 kva. self-cooled, 84,000 kva. forced air cooled, 161/132-13.2 kv. This bank will carry the output of generators 2 and 3. Provisions have been made for a duplicate bank for generator 4 and the fifth generator. The neutrals of the 161-kv. windings are grounded through one 52-ohm reactor for each bank. The neutral for the 66-kv. winding, bank 1, is solidly grounded.

Ring Bus

The 154-kv. connections will be a 4-circuit ring bus installation for the initial operation of the switchyard. It can later be expanded into a main bus and transfer bus as circuits are added. All 154-kv. breakers are rated 1,200 amp., 2,500,000 kva., 5- and 8-cycle opening. They are pneumatically operated and connected for a 1-shot reclosing operation after an automatic no-voltage or synchronism check.

Retired 132-kv. breakers have been reconditioned for 66-kv. service, and each has been provided with a reclosing relay. The 66-kv. line relays are coordinated with the line fuses at customer's substations. The breaker is tripped once by the high-speed line relays, but if the fault persists, following an instantaneous reclosing operation, the high-speed relay trip circuit is blocked to allow time for the line fuses to operate.

Main buses are of standard galvanized pipe with the joints welded and zinc-sprayed. The transformer delta buses are standard copper pipe. Other connections required are either copper pipe or cable. Transmission line ground wires are clamped to the top of the steel structures and connected to the station grounding system. Overhead ground wires provide a protective shield for the equipment in the switchyard.

Oxidation Inhibitors in Insulating Oils—II*

General nature of added inhibitors—Need for standard test to evaluate effectiveness—Contrast with inhibition of lubricating oils—Difficult to justify use of inhibitors in insulating oils—Focus on one oil and one inhibitor suggested as beneficial move

L. J. BERBERICH†, Westinghouse Research Laboratories, East Pittsburgh, Pa.

MANY PAPERS and patents can be found in the literature of the last 20 years describing compounds which are effective in retarding the oxidation reaction in oils. Chief among these are the aromatic amines, aromatic sulfides and disulfides, aromatic phenols, and aromatic phosphates and thiophosphates. There are certain compounds which appear to owe their effectiveness to either deactivation of the metal or reacting with the metal surface in such a way as to eliminate its catalytic action. The phosphorous compound, tert-amylphenyl phosphite, is an example of this type. There is also a third type of compound which is believed to be a "sludge solvent". These appear merely to increase the solubility of the oil for the sludge, thus preventing its precipitation. Nitrobenzene and nitronaphthalene are examples of this type.

Test Comparisons

It appears futile to attempt to compare the effectiveness of the many inhibitors described in literature, for no thorough tests covering a wide range of compounds in conventional transformer oils have been made under the same test conditions. It is impossible to compare test results unless (1) the tests are made on the same oil, (2) the same test criteria are used, (3) the same test conditions are used, and (4) the same metal catalysts are used. There is no standard test for evaluating inhibitors for insulating oil use, and the need for one is apparent. The development of a satisfactory test procedure, however, is an extremely difficult problem in itself. In view of this situation, the results on only a few representative inhibitors will be discussed.

Balsbaugh and his co-workers at the Massachusetts Institute of Technology have made a study of the oxidation of a considerable number of oils in which the electrical properties are emphasized as test criteria. They have also investigated to a limited extent a series of oxidation inhibitors (Fig. 1). The inhibitors were added in 0.1 percent concentration to an experimental oil refined to the point where it was essentially free of aromatics.

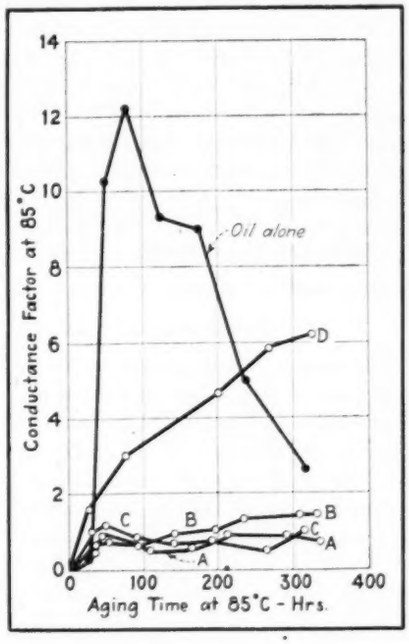


FIG. 1—Effect of various inhibitors in limited oxidation

A. Oil plus 2, 6-di-tert-butyl-4-methyl-phenol
B. Oil plus n-benzyl-p-anisidine
C. Oil plus beta-naphthol
D. Oil plus diphenylamine

Sludge Inhibition

The tests were made at 85 deg. C. in the presence of copper with only a limited amount of oxygen (105 cc. of oxygen per kg. of oil) available to the oil in a closed system. The "conductance factor", which is a number proportional to the conductance of the oil, was measured as the oil aged. Inhibitors (A), (B), and (C) appear to be very effective and (D) only somewhat effective. The tests, which were directed more toward oils for cable use, were not run long enough to enable the evaluation of their use in transformers. Work of this type is very valuable but represents only a start in the problem of evaluating inhibitors.

Sludge Criterion

Trautman investigated a number of inhibitors in a typical transformer oil. In this work, sludge formation was used as the test criterion. The tests were carried out at 120 deg. C. in the presence of air and copper. The time required to form a fixed and conveniently measurable amount of sludge was used as one of the test criteria. Some of Trautman's results are given in the table.

It will be observed from the table that some of these inhibitors are the

* The preceding installment appeared in the February 17, 1945, issue of ELECTRICAL WORLD.
† Section Engineer, Insulation Department

same as those investigated by Balsbaugh. Benzyl-p-anisidine and 2,6-di-tert-butyl-4-methylphenol are seen to be effective in both types of tests. The table also shows that a combination of two inhibitors is more effective than either inhibitor alone. This has often been found to be the case.

Effect of Various Inhibitors on Sludge Formation in Transformer Oil

Inhibitor and Amount Added Percent by weight	Time to Form 0.1% Sludge—Days
None—oil alone	7
Benzyl-p-anisidine 0.1%	17
Benzyl-p-anisidine 0.5%	60
Benzyl-p-anisidine 0.1% plus 2, 6-di-tert-butyl-4-methylphenol 0.3%	60
2, 6-di-tert-butyl-4-methylphenol 0.3%	14
Benzyl aniline 0.3%	11
Trithiophenyl phosphate 0.3%	22
Trithiophenyl phosphate 0.3% plus 2, 6-di-tert-butyl-4-methylphenol 0.3%	52

Tests such as these come closer to the transformer oil practice. However, tests in actual transformers must be made before their practical value can be determined.

Selective Inhibition

In some cases the same compound may act to inhibit oxidation in one type of oil and promote oxidation in another type of oil. A striking example of this is shown in Fig. 2, data for which were obtained by Dr. H. E. Mahncke of our Laboratories. The test consisted of a modified Sligh test carried out at 175 deg. C. with no metal catalyst. Oxygen absorption was used as the test criterion. Oil A is a naphthene base oil with a viscosity index of 76, and Oil B is a paraffine base oil with a viscosity index of 105. Both of these oils were aged with and without ½ percent of Neozone A (phenyl-alpha-naphthylamine). Neozone A is seen to be very effective in Oil A and surprisingly enough promotes oxidation in the case of Oil B.

Very similar results were obtained when the aging was carried out at 100 deg. C. in the presence of brass, iron, zinc, and aluminum. The time scale, however, in this case was in hundreds of hours instead of hundreds of minutes. Not all inhibitors show this behavior, but many of them show no or very little effectiveness in one type of oil and considerable effectiveness in another type of oil. Thus, the specificity of most inhibitors further complicates their evaluation and use.

Many inhibitors are very effective in retarding oxidation of oils refined to the point where they approach a white oil. The aromatic amines, sulfides, and phenols appear to have attractive possibilities in this type of oil. Some of them retard both sludge and acid formation for relatively long periods of time. However, there are several disadvantages which must not be overlooked. These are: (1) The cost of a white oil is considerably higher than a conventional oil. (2) The inhibitor is eventually consumed and then acidity forms at a rapid rate.

Practical Considerations

As far as the writer knows, little use of inhibitors has been made in insulating oils up to the present time. In striking contrast, inhibitors have come into quite extensive use in the various types of lubricating oils and internal combustion engine fuels. There are a number of reasons for this, chief among which are the following:

1. The life of the electrical apparatus in which insulating oils are used is long, 20 or more years, and the evaluation of an inhibitor in terms of such a long life is an extremely difficult problem.

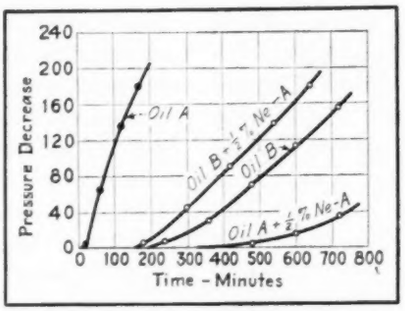


FIG. 2—Oxygen absorption by modified Sligh test at 175 deg. C; no catalyst

2. Since the cost of the oil is only a relatively small fraction of the total cost of the apparatus, there is not any great incentive to take the risk which the use of an untried inhibitor involves.

3. The universal inhibitor has not yet been found, that is, one that is effective in a wide range of oil types.

4. The use of different inhibitors by the various oil suppliers would bring about complicated storage and field servicing problems. There is no assurance that two oils containing different inhibitors can be mixed without deleterious effects. Thus storage tanks may be necessary for the oil from each supplier.

5. Modern electrical oil-filled apparatus is more and more approaching a type of construction in which contact of oil with oxygen is avoided, thus further reducing incentive for using inhibitors.

Inhibition Unattractive

In the face of the situation just described it is difficult to make an attractive case for the use of inhibitors at the present time. What the future holds, of course, cannot be predicted, but the adoption of one oil and one inhibitor by the whole industry would certainly help the inhibitor cause. The use of inhibitors in reclaimed oils appears to offer some possibilities. However, large scale reclaiming has not come into general use in this country because the price of new oil is so low that such operations are not very profitable. This picture can change in the future, especially if we should reach the point where we will be faced with the low petroleum reserves, as is the case now with many of the European countries.

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Best Place to Work

Emphasizing friendliness and personal interest, the booklet, "The Best Place in Nashville to Work," recently printed by Nashville (Tenn.) Electric Service for information of new- and old-employees, is definitely an effort to sell employer to employee. The "what" and "how" of the utility are explained sufficiently, but the greater part of the space in the booklet is taken by text and pictures in terms of "who", that is, the employee himself and the people he works with A noteworthy feature is that in the whole 32 pages the word "don't" occurs only once and then it is used informatively, not in admonition.

In no sense is this an instruction book, full of rules of conduct and of performance, telling them what they should and should not do, with which new employees are often greeted when they report for work the first day. Rather the theme of "welcome to our midst" appears on every page, not just on the first.

Editorials

S. B. WILLIAMS, *Editor*

Street Lighting Will Attract Industry and Labor

AFTER TOO LONG a period of hibernation, interest in street lighting is waking up.

Cities with war-swollen populations wanting to keep up their industrial activity and communities wondering how they can bring back their workers who were lured away by war jobs are becoming conscious of the necessity for providing some of the intangibles if they are to attract and hold an ample supply of labor. Unsafe streets at night, dimly lighted and unattractive shopping areas, and mounting traffic accidents with high insurance rates will drive away labor and industry. After the war communities will be in competition for new industries, not so much a competition of manufacturing advantages as of living advantages. Will the town be a good place to live in and bring up children? That will be the big test.

High in the list of things that can make a town a good place to live in is its safety after dark and not far below it is the attractiveness of its downtown area at night. For several years The Street and Traffic Safety Lighting Bureau has been plugging away at the night-driving hazard and, while it has accomplished a great deal in awakening people to this national problem, it cannot do the job alone. It is now asking the utility industry to join it in the job of educating community leaders to the need for adequate and modern street lighting. Since every utility is deeply interested in the growth and opportunities of the communities it serves there should be no question about cooperation.

It is true that improved street lighting would mean added load, but that in itself is relatively unimportant by comparison with the far greater load possibilities from a community that attracts industry and holds its workers because it is a good place in which to live.

Twenty-five years ago a city wasn't up to date if it didn't have a white way. But the world has moved on and white ways are no longer modern. Today we need to relight all of our traffic streets. With interest awakening now is the time to act. Feed people information that affects their home and they will not be long in demanding what is right.

Red Cross Giving

FOR MOST PEOPLE the annual War Fund drive of the Red Cross, now in progress, represents their only contribution to the work of this great organization. To millions of others, however, money, though generously given, is the least of their contributions to Red Cross. In every community there are Red Cross workers who, somehow or other, are finding the time to do their bit toward easing war-caused suffering. Not all of these groups are community in nature, many are among the employees of companies. On the front cover of this issue are pictures of some of the ways power utilities through their employees and the use of company facilities are daily helping this work. There are Wisconsin Electric Power girls working as Red Cross nurses aides in Milwaukee hospitals, Connecticut Light & Power blood bank, dolls made by Commonwealth Edison girls for children of hospitalized service men and a community surgical dressing group at the main office salesroom of Pennsylvania Power & Light.

We take this opportunity to commend the electrical industry and its employees on their support of and participation in the work of Red Cross and to urge that great as their contributions of money and time have been in the past they be larger than ever in this year of greater need.

Insulating Oil Research Advances

FOR SOME YEARS the behavior of water in oil has been a major object of study in relation to preventive maintenance by engineers intimately interested in insulation. Two main goals have been (1) how to control the water content of insulating oil in service so to prevent a reduction in dielectric strength of the oil itself or a similar deterioration in an immersed insulation: and (2) investigation of the possibility that the tolerance of an oil for water may be an index of its life condition in terms of deterioration.

It appears that water totally in suspension in oil may be a dangerous poison electrically speaking. Data indicate that as low as 10 parts per million of water in suspension may reduce the spark value in the vicinity of 25 percent. On the other hand, water in solution, even as high as 100 parts per million, may not cut down spark value appreciably, and dielectric loss and power factor tests on such liquid insulation may give values so low as to fail to distinguish it from water-free oil by any ordinary sensitive measuring apparatus. Research is progressing in the direction of studying both electrically active and non-active water in oil and considerable progress has been made in defining the spheres and developing such procedures as filtration by blotter press, centrifuging, saturation, distillation and emulsification.

This work in a physio-chemical area seems likely to yield increasingly valuable results to the operating engineer when further exploited. It means thinking of liquid

water not as H_2O (hydrol) molecules alone, but as groups or clusters which may behave as a single molecule while in fact they are di-hydrols, tri-hydrols $(H_2O)_2$, $(H_2O)_3$ and so on, performance being affected by temperature. The search for primary standards is making headway, and it is hoped that significant and accredited valuations can be had in due course for direct application in diagnosing insulating liquid condition and prospective life in relation to oil and perhaps other liquids found increasingly useful in commercial apparatus.

A Practical Angle on Jobs for Veterans

NO MATTER WHAT or how much management says about intentions and plans for re-employment of the discharged veteran, no matter if the president writes him pre-discharge letters telling him his place in the company-family is waiting for him, no matter if all the vice-presidents have been instructed to crowd around with welcoming handshakes when he turns up and applies for his old job or a better one—none of these will mean very much unless the veteran finds consideration and understanding among the people he is put to work with, particularly unless he gets these from his foreman or other immediate superior.

We had been beginning to think that a lot of all we heard and read concerning dispositions made and making for suitable placement of the discharged veteran in the coming world of peace was too much top side. And it did not seem to us that it was getting down into the organization, at least it did not appear so.

We are pleased, therefor, to call attention to a little book entitled "You and the Ex-Service Man," prepared by the training and education department of John A. Roebling's Sons Co. and put into the hands of every Roebling foreman and supervisor. This book recognizes that it is the people and circumstances immediately surrounding the veteran in his re-employment that will determine success or failure in the task of turning the soldier into a useful and happy citizen. And in specific terms it teaches the foreman how to discharge his responsibility to assure the result will be success.

It's Still I^2R

FROM LISTENING to many talks and discussions and from reading many papers and articles on high frequency electric heating, we have reached one definite conclusion. It is that the subject has become so cluttered up and infested with esoteric terms and considerations that it may easily bog down in its own technology.

Ask an expert how to figure the amount of heat for a given piece of work and he rushes to the nearest blackboard and graps the biggest hunk of chalk in the gutter at the bottom. He knows he's going to need the biggest one. Then he starts writing the equation for W, which is the power that is converted into heat. After the "equals" sign, he inscribes a long series of hieroglyphs, symbols and numbers that cause to ache every head but his.

Therefore it is indeed a relief when one of the initiated, no doubt an irrevelant person whose admission to the arcanum is now known to have been a mistake, comes forward and calmly states that the power converted into heat in a high frequency set-up is the same old I^2R which children destined to become electrical engineers learned at their mothers' knees. This revelation of the basic simplicity of the equation occurs in the opening paragraphs of an article on high frequency heating in this issue of ELECTRICAL WORLD.

Of course, it is practically impossible to take direct measurement of current in a high frequency circuit. And determination of resistance is a little difficult, too. Maybe it is really necessary to mess around with the hieroglyphs and symbols in order to reach the value of heat-producing power. But there is no necessity to stupefy the innocent inquirer with a spate of intricate mathematics when he asks how and how much heat is produced. He will be just as informed and much happier with the simple I^2R.

They Are The Company

FOR THE UTILITY MAN with the "I want to know" frame of mind about his company Detroit Edison has written a handbook titled "You are the Company." It's no ordinary slick-paper exhibition of corporate megalomania. Surprisingly enough, moreover, there isn't a financial statement in it anywhere. Instead its thirty-five modest pages answer sensible questions that ordinary people, either customers or employees, might ask: "Why do public service companies differ from other businesses?"; "How do I figure my bill?"; "Why is it fair to give the same rate to farm customers? It must cost a lot more to serve them."

There are suggestions, too, on what to do 'till the "doctor" comes:—"If someone tells you that wires are down"; —"that his lights are out";—"that someone has been injured by company equipment";—" that he wants a pole removed from the front of his house."

Certainly many utility people know the answers to these questions but there are a lot more who don't. The boss or a vice-president isn't going to be on tap for every emergency.

The office boy, the steno, the ledger clerk are utility people, too, and proud of it. Arm them with the answers to the crisis questions and give them a chance; they will hold up their end in an emergency, conversational or physical, as well as anyone.

But the answers they need aren't found in balance sheets or in pretty pictures of transmission towers against the sky. Management must find out what these folks need to know to hold their own and then give them the answers in straightforward, clear, simple English. They are the company and proud of it. Let them reflect their pride!

WASHINGTON COMMENT

By R. N. LARKIN, Washington Correspondent

Under 30 Deferments to Be Reviewed by OWU

WHAT SHOULD BE THE LAST—and which will doubtless be the most severe—program for stripping industry of its workers of fighting age is now under way at the insistent demand of the armed services.

The electric power industry and other utilities stand to be hit hard, just as all other industries do, but they have the advantage of having their deferred men under 30 years of age reviewed by the Office of War Utilities in competition with no other industry. While this does not mean that the electric power industry will get deferments for a greater proportion of its young men than other essential industries, it does mean that the selection job will be done by an agency which for the past four years has done as good a job for its industry as any agency in Washington and a better job than most. The selection job will be based on the intimate knowledge of the operating electric utilities which OWU has acquired during these years and will be aimed at insuring that no shutdowns occur because of the induction of men without whom a plant cannot operate.

Deferments to be Limited

The dismal fact is a simple one. At this late date, three months after the more conservative of the military experts thought we would have won the European war, at a time when we had expected to be wheeling to face Japan and mustering older men out of the service, the 300,000 occupational draft deferments which have been granted men under 30 are all to be cancelled. A relative few will be restored after the status of each young man has been studied by the federal war agency responsible for the industry in which he works.

The plan is that a number of government agencies will scan lists of occupationally-deferred men under 30 in each plant, and will certify a limited portion of them to local draft boards for renewal of their deferments. The draft boards, of course, still retain their legal right to make final determinations themselves, regardless of any and all certifications, and doubtless a few men recommended for deferment will be lost. In general, however, federal agencies have edged the draft boards into an ever-smaller corner over the past two years, by piling compulsory review procedures on top of each other to a point at which, for practical purposes, they can halt the induction of about any man they want retained in civil life.

Unlistables

Employers are to list their occupationally-deferred young men in order of importance. They may not list any man who is replaceable, nor may they list any man who is engaged in "planning, research, development, production or construction for postwar purposes." Employers who are not on War Manpower Commission's Essential Activities list may not list anyone. Employees are considered replaceable, regardless of their job, if, by recruitment or upgrading, or by any other means, a replacement may be developed during three months of intensive training. No man may be listed who is not performing an indispensable job, one which unperformed, would bring to a halt the particular operation in which he is employed.

OWU will be the certifying agent for privately-owned electric utilities and electric cooperatives, performing this job on delegation of authority from WPB which is certifying agent for a vast number of industries. Municipal power plants will certify their own men to local boards. That this is no undue bargain is to be seen from the fact that employees of municipal systems will compete with firemen, policemen and other municipal employees.

Employees of federal power plants will be certified by the federal review committee for government deferments, which in a year or more of operation has demonstrated itself to be a very hardboiled outfit, sitting as it does under the sceptical eyes of Congress.

Need to Determine

No one should expect that any flat quota system will be applied to companies in the power business. Companies in tight labor areas are going to get more deferments than those in less tight areas. Men with the most important operating jobs in loose labor areas may go while men with less important but still indispensable jobs in tight areas may stay. In an area where no replacement can be found for a man who might be upgraded to replace a draft-eligible, there are more chances of deferment than in another place where a replacement for the man to be upgraded can be found. Every company's list of requested deferments will be judged on an individual basis in terms of the need for manpower in that company's areas as compared with the need for manpower in another area. The method is arbitrary, to be sure, and will doubtless be much more severe in its application to some companies than it will be on others.

The only happy aspect of the whole matter is the fact that OWU has demonstrated its integrity and its professional competence in the past on numerous other controversial problems. The industry can rely on fair treatment in the handling of a problem which can only be settled by distasteful fiat.

OWU is anxious to hear from any company which feels, after surveying the damage done by the certification process, that it just will not be able to operate. A complete presentation of the company's problem will be studied, and if it develops that the company won't be able to get by without relief, adjustments will be made. It is, of course, OWU's job to see that the power business continues to operate. But any such appeal will really have to be conclusive.

NEWS OF THE WEEK

House Sends Roosevelt Rivers and Harbors Bill

Representative Mansfield Indicates That There Will Be Other Similar Bills Introduced During This Congress—Action on Williams Confirmation Awaits Printed Record of Hearing—MVA Measure Delayed

The House passed and sent to the President last week a $381,968,000 Rivers and Harbors Bill containing seven power projects in Texas, the Southeast and Northwest.

The bill sped through the lower chamber—as it had through the Senate—without opposition or much debate after members agreed to withhold controversial projects which caused the same bill to die last winter as the 78th Congress adjourned.

In pushing the bill through the House, Rep. Joseph J. Mansfield, Texas Democrat and chairman of the Rivers and Harbors committee, disclosed that there may be several more such bills during the present Congress. It had been common knowledge that another Rivers and Harbors bills would be forthcoming this session, to contain project reports now being prepared by the Army Engineers, and the controversial projects left out of the present bill, but Mansfield's statement that several more are coming was the first intimation that more than one would be introduced.

The nomination of Aubrey Williams as administrator of the Rural Electrification Administration was stalled while Agriculture Committee members awaited completion of the printing of a lengthy record. In some quarters, it was expected that a vote on Williams by the Senate as a whole would be held up until administration leaders can "take the temperature" of the upper house by bringing out the appointment of Henry Wallace as Secretary of Commerce. Wallace's nomination was to be considered on or soon after March 1, and probably will entail at least two days' debate, it is indicated.

Associated Press late last week reported that 10 of the 20 Agriculture Committee members had told AP they intended to vote against a favorable report for Williams, while eight had expressed intentions of voting favorably on the nomination. Two more were reported in doubt. A tie vote would mean an unfavorable report.

The Senate deferred action for a week on the resolution introduced by Sen. James E. Murray, Montana Democrat and author of the Missouri Valley Authority Bill, seeking to remove the measure from the Commerce Committee and have it considered by the Agriculture and Forestry Committee, which handled TVA legislation 12 years ago.

Murray's resolution was expected to provoke a floor fight of some proportions in view of the insistence of Sen. Josiah Bailey, North Carolina Democrat and Commerce Committee chairman, that the bill would get a fair hearing before his committee. The Murray resolution, however, was not expected to hurry appreciably consideration of MVA legislation, which will doubtless be sidetracked in the Senate by such matters as the Bretton Woods international monetary agreement, ratification of which was asked recently by the President, and an international security organization, a treaty for which the President wants in the hands of the Senate by summer.

The House Irrigation Committee heard Deputy Reclamation Commissioner William Warne describe a $3,000,000,000 post-war reclamation program which the Interior Department's Reclamation Bureau is now considering. Projects valued at one-third of this figure already have been authorized by Congress, Warne said, adding that new legislation will be required for the remainder. Work on these projects, he said, would be fundamental, and easily adaptable by whatever river basin authorities may hereafter be developed.

The Senate's Small Business Committee, headed by Senator Murray, meanwhile, began hearings on the future of light metals, with numerous experts in and out of government scheduled to testify on many phases of the problem. Chairman David Lilienthal, of the Tennessee Valley Authority, and Dr. Paul J. Raver, director of the Bonneville Power Administration, are scheduled to testify March 21 on the role of public power in the future of light metals as it relates to opportunities for small business in the south and west. Appreciable testimony also will be taken on disposition of government-owned light metals plants, in conjunction with which some power plants have been installed.

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Rural Electrification Will Cost Utilities $290,000,000

In extending rural electrification within the next three years electric utilities will spend $290,000,000 and the newly served customers $500,000,000 for wiring and initial equipment, a preliminary report to Edison Electric Institute by its Commercial Planning Committee shows.

Of the prospective 1,000 customers, 600,000 live on farms, the other 400,000 occupy rural non-farm homes.

The report shows that the farm electrification job is half done with 2,700,000 of the nation's 5,200,000 farms having service. The areas where the greatest need for electrification exists are the Midwest and South Atlantic States.

Farmers in a questionnaire revealed that their first ten choices in the use of electricity were for water systems, refrigeration, including home freezer cabinets, brooders, water heaters, feed grind-

ers, milking machines, elevators, barn ventilators, farm motors, and cream separators.

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REA Suspends Loans to Kentucky Co-ops

The Rural Electrification Administration has suspended further loan allotments for Kentucky until credit risks of local cooperatives can be studied. The order signed by William J. Neal, acting REA head, was read to managers of state co-ops meeting recently at Lexington.

Cause for the order was the recent action of the Kentucky Public Service Commission allowing the Kentucky & West Virginia Power Co. to build 1,156 miles of rural lines in 16 counties in eastern Kentucky (ELECTRICAL WORLD, February 24, Page 6).

REA cannot make loans unless they appear to be self-liquidating, Neal explained. If power companies are going to be allowed to establish lines cutting across those of co-ops, future loans must be examined to determine if they are good risks.

Some $3,000,000 of allotments are affected immediately, as well as a $30,000,000 post-war expansion planned by the co-ops.

The co-ops will appeal the state commission order and if necessary will carry the fight to the courts.

Kentucky is the third state where such suspensions have been ordered. Allotments in Virginia were lifted after seven months and in West Virginia after four months.

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Columbia Directors Resign

William M. Hickey and O. Kelley Anderson have resigned as directors of the Columbia Gas & Electric Corp., and the number of directors has been reduced accordingly.

The resigning directors represented the United Corp. on the Columbia board of directors and gave as their reason for resigning the disagreement between them and the majority of the board on the proper steps to achieve compliance by the Columbia System with Section 11 of the Public Utility Holding Company Act of 1935.

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Appoints Electrical Board

To prevent the installation of faulty wiring, West Memphis, Ark., has appointed an electrical inspector and an electrical examining board to examine applicants for electricians licenses.

Wolfe and Mayott Resign from OWU

Two three-year veterans of the Office of War Utilities left the organization this week.

Harry C. Wolfe, until recently chief of the inventory control branch and since its abolishment a special assistant to OWU Director Edward Falck, transferred to the Budget Bureau where he will head an organization which reviews proposed federal public works programs to determine their relation to presidential policy and overall program.

Wolfe came to the power branch of WPB in January, 1942, and was deputy chief of its research and statistics branch, later becoming deputy chief of the inventory control branch soon after it was organized in March, 1943. Later he became chief of the branch, continuing in this position until the end of last year when the branch was abolished.

Before coming to WPB, Wolfe was affiliated with the American Friends Service Committee in the development of various types of cooperatives and before that had helped organize several REA cooperatives. For several years prior to 1939, he was consumers' representative for the Monongahela West Penn Public Service Co.

Mayott Returns to Hartford

Clarence Mayott returns to the Hartford Electric Light Co. after almost three and one-half years with OWU and its predecessor organizations.

Mayott joined the staff of J. A. Krug, then chief of the power branch of the Office of Production Management in October, 1941, to help organize the curtailment program required to alleviate the power shortage in the southeast that year caused by a severe drought. Thereafter, he became chief of power pooling for the power branch, later becoming regional power supply engineer for the Southeast. Still later, the Southwest was added to his area jurisdiction. This month he was made deputy chief of the power division's power supply section. Before joining OPM, Mayott had been manager of the Connecticut Valley Power Exchange since it was organized in 1925. On his return, he will do special work for Hartford Electric.

Edgar S. Coffman has been named chief of rates and research for the Federal Power Commission succeeding H. Zinder, who resigned. Coffman was with FPC from 1933 until 1944 and was principal rate investigator when he resigned early last year to become principal consultant on power and gas matters for the Reconstruction Finance Corporation. While with RFC he was power procurement officer for Defense Plant Corporation, Metals Reserve Corporation and Rubber Reserve Company.

He is a graduate of Purdue University and a member of the American Institute of Electrical Engineers.

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Court Halts Okanogan P.U.D.'s Finance Program

Extension of an injunction against Okanogan Public Utility District in Washington, which prevents it from continuing with bond issue plans to finance acquisition of Washington Water Power Co. properties in Okanogan County, was issued by the state supreme court in mid-February on application of the power company and citizens of Okanogan County.

Extension from February 9 to March 30 carries the injunction through to the date when the legality of the proposed bond issue will be determined by a supreme court hearing. Suit was brought when the P.U.D. commissioners voted to issue bonds $500,000 in excess of the $2,227,531 valuation placed on the utility's properties by a county jury in January, 1943. The suit challenges the commissioner's power to raise the bond amount set in their original resolution following the valuation award.

Meanwhile, Washington Water Power raised a new issue in the P.U.D. controversy when it filed action in superior court to determine if it must sell power wholesale to the district which intends to be a competitor. The P.U.D. is not subject to state or federal utility regulation and therefore not a utility, the suit contends, and the company has never been required to sell electricity wholesale to a purchaser for resale to its own customers.

Hearing on a decree of appropriation by the district, originally scheduled for late January, has been postponed indefinitely while supreme court litigation is in progress, it was reported.

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January Water Supply Normal Except in Midwest

With the exception of Ohio and Indiana and parts of southern Florida, water supply conditions throughout the United States were nearly normal at the end of January. In certain places cold weather has cut the streamflow but this condition in turn will serve to control floods in the coming months. Snow accumulation in Pennsylvania, New York, and in New England is cause for some concern. Floods, however, are not likely to be severe.

OWU Will Certify Utility Employees for Deferment

Ruling Applies Only to Privately Owned Companies—Municipal Systems Recommend Own Deferments—Falck Explains Procedure Followed under New Regulations—Older Men May Fail Physicals

Large-scale induction of occupationally deferred men under 30 years of age, with only a "hard-core" of vital workers in this category left to industry, has been ordered by the government to meet increasing demands for young fighting men.

The deferment of such men under 30 as are allowed to remain out of uniform will be handled by certifications by about 15 federal agencies, which will choose the most vital men in each plant and recommend their continued deferment to local draft boards.

Only factor mitigating the drastic nature of the new manpower program is the fact that about 50 percent of the men between 26 and 30 summoned for induction may be expected to be rejected for physical reasons.

New Class Established

National Selective Service, meanwhile, drew the manpower net a little tighter by formally establishing a new class of registrants, those ranging in age from 30 to 33, inclusive who hereafter will occupy essentially the same status as has been occupied up to now by registrants aged 26 through 29.

Hereafter, registrants in the 30-33 group must, in order to be eligible for occupational deferment, be "necessary to and regularly engaged in" an activity in war production or in support of the war. Heretofore, these registrants were required only to be engaged regularly in a war-supporting activity to be eligible for occupational deferment. Selective Service's memorandum directs that fathers in the 30-33 group be given more consideration than nonfathers if all other factors are equal. Men aged 34 through 37 are eligible for deferment if they are regularly engaged in war or war-supporting activity.

The Office of War Utilities will certify deferments for the privately owned electric power industry and for REA cooperatives. Municipal systems will recommend their own deferments, and employees of federal power systems will be reviewed by a federal deferment committee.

In an administrative letter to the power industry, OWU director Edward Falck reviewed the procedure by which companies will certify their necessary men. Utilities were required to furnish to OWU by March 5 a list of all its men who on last January 1 were between 18 and 29 years of age, inclusive, and who were then classified as 2-A or 2-B, not including 2-A or B -L or -F. Lists are to be in order of importance of the men named therein.

In addition, employers are to file two sets of revised form 42-A special for each man who meets deferment criteria and for whom the employer feels deferment must be obtained. Employers must certify that the list is filed with only one certifying agency. Local draft boards will not normally grant occupational deferments unless they are so certified.

Only men who are doing indispensable work in an industry listed at least as essential by the War Manpower Commission may be listed. The electric power industry, listed by WMC as critical, qualifies here, but not all of its employees are considered to be doing indispensable work. Men listed must be irreplaceable by any means, recruitment, upgrading or otherwise. Men who can be replaced by an available recruit or transferee after three months of intensive training are considered replaceable. Men engaged in "planning, research, development, production or construction for post war purposes shall not be certified for deferment."

When these lists and deferment forms are submitted to WPB district managers, electric companies are to send to OWU in Washington telegrams disclosing the total number of employees who on January 1 were between 18 and 29 and who were 2-A or 2-B, and the number of these for whom deferment is requested.

If form 42-A special is not immediately available, OWU warned, lists should be filed without them and the forms obtained from local draft boards and filled out as quickly as possible. Since utilities are being treated as a special group within WPB, which is certifying agent for many industries, lists should have the word "UTILITY" marked plainly in the upper right hand corner.

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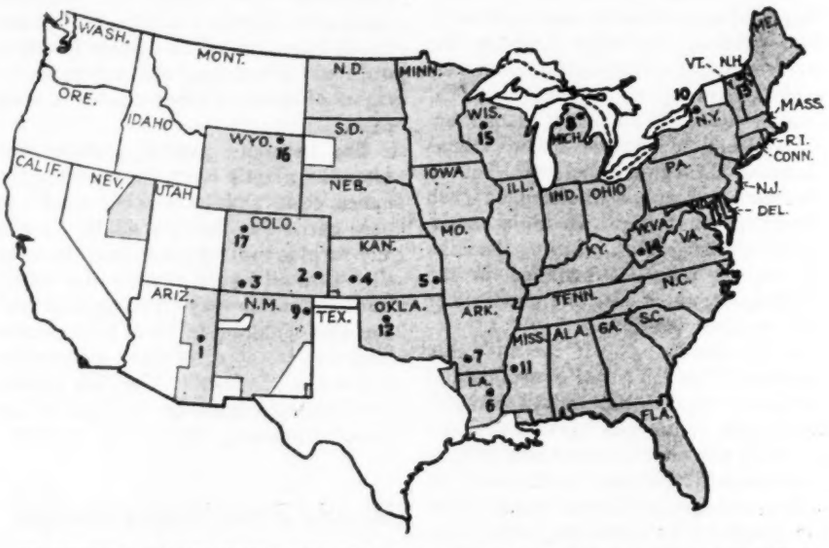
Gallup, N. M., Buys Plant

Purchase by Gallup, N. M., of Gallup American Coal Co.'s electric power plant at Gamerco, which formerly sold power to the municipal distribution system, has been negotiated for $125,000, it was announced recently. The plant is rated at 5,000 kw.



BROWNOUT IN THE UNITED STATES—Areas exempt from brownout regulations are unshaded. Cities and adjoining cities exempt are indicated by the numbers: 1. Snowflake, Taylor, Showlow, Ariz.; 2. Lamar, Colo.; 3. Pagosa Springs, Colo.; 4. Garden City, Kans.; 5. Walnut, Kans.; 6. Monroe, La.; 7. Hope, Ark.; 8. Hillman, Mich.; 9. Clayton, N. M.; 10. Copenhagen, Rouses Point, N. Y.; 11. Yazoo City, Miss.; 12. Stillwater, Okla.; 13. Derby Line, Vt.; 14. Rainelle, W. Va.; 15. Radisson, Wis.; 16. Buffalo, Basin, Wyo.; 17. Aspen, Basin, Colo.

Length of Extensions Limited by OWU Rule

U-1-f Amended to Impose Limit of 5,000 Feet on Extensions to Industrial, Commercial Users

The Office of War Utilities has amended supplementary order U-1-f to impose a 5,000 ft. limit on the length of extensions to preferred industrial and commercial consumers, limiting to 250 ft. the allowable length of extensions to seasonally occupied dwellings, and making certain other changes.

Paragraph (b) (2) has been changed to provide that notwithstanding the length limits of Schedule 1 in the order, the length of secondary circuits for operation at 600 volts or less, if underbuilt on existing poles, need not be included in determining the length of allowable extensions. A new paragraph, (b) (5), requires that the smallest quantities and sizes of equipment and conductor which will furnish service at minimum standards must be used on U-1-f extensions.

Paragraph (d) has been changed to allow the completion of work on U-1-f extensions begun prior to the issuance of this amendment provided, in the case of overhead construction, that clearing and staking of rights of way have been completed and not less than 20 percent of the required poles are in place. Underground construction may be completed if any work has been done.

Limit Transformer Placement

In restricting to 250 ft. the allowable length of extensions to seasonally occupied dwellings the order provides that no transformer may be installed on such extensions except as a replacement. Extensions of 1,000 ft. per consumer are allowed under Schedule 1 to dwellings occupied throughout the year, but no transformer may be installed on such extension other than for replacement, unless a refrigerator, washing machine or electric range is installed in the dwelling, in which case one transformer per consumer is allowed.

In limiting to 5,000 ft. the allowable extension to an industrial or commercial consumer listed in Schedule A of CMP Regulation 5, the new version of U-1-f provides also that no extension costing more than $10,000 may be erected. The order provides also that no limitation on the length of an extension, other than the $10,000 ceiling, shall be imposed on an extension to operate an electric motor for oil well drilling or pumping.

The 5,000 ft. limitation applies not only to businesses listed in Schedule A of CMP Regulation 5, but also to extensions to electric, water, gas, steam heat, telephone and telegraph utilities; industrial and commercial consumers in the petroleum industry other than retail marketers; industrial or commercial consumers engaged in the business of mining or burning refractories who have been assigned serial numbers under preference rating order P-56; industrial or commercial consumers engaged in radio communication or broadcasting; and hospitals. Except for these industrial and commercial consumers, no extension shall exceed 1,000 ft., which shall include primaries, secondaries and service drops. No transformers may be installed except for replacement.

Extensions to serve additional street lighting facilities must satisfy all the following conditions:

Additional lights must be certified in writing by local public authority to be necessary for public safety; not more than 500 ft. of extension may be installed per street light to be served; no distribution transformer may be installed except to replace one in service; and no additional street lights may be installed closer than 250 ft. to another street light except as necessary to provide a single light at an intersection or at the ends of a bridge, tunnel or viaduct.

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4th Class Kentucky Cities May Use Utility Surpluses

Fourth class cities in Kentucky may use surplus funds from municipally owned utilities for general purposes, the Court of Appeals ruled unanimously in upholding the claims of Mayfield against its Electric Plant Board, created by its City Council to operate Mayfield utilities. The ruling did not touch on rights of cities of other classes in such cases.

The appellate opinion declared that after the plant's operating and maintenance costs and its sinking fund had been cared for, the City might transfer any surplus to its general fund, that the City Council could require the waterworks plant to pay "tax equivalents" and also could put in effect a retroactive reduction in rates the plant charged the City for fire hydrants. The "tax equivalent" charges must be charged to the plant's operating costs.

•

Would Free Maine Co-ops

A move to free REA cooperatives in Maine from control of the Public Utilities Commission has been introduced in the legislature. The bill would allow the co-ops to run power lines wherever they choose without first obtaining P.U.C. approval.

San Francisco Gets Extension from Court

Permission for the city of San Francisco to continue selling Hetch Hetchy power to the Pacific Gas & Electric Co. for a period of four months past the March 1 deadline established in an earlier court action was granted February 26 by Federal Judge Michael J. Roche.

The extension, agreed to by Arthur J. Goldschmidt, chief of the power branch of the U. S. Department of the Interior headed by Secretary Harold Ickes, was granted in order that San Francisco might have an opportunity of working an "orderly system" for compliance with the Raker Act which forbids sale of Hetch Hetchy power to a private utility.

Called as a witness for the city, Mayor Roger Lapham testified that San Francisco is presently engaged in negotiations with the Turlock and Modesto Irrigation Districts and the two Kaiser-owned Permanente plants near San Jose, Calif., for the sale of its excess power. The mayor declared that a peremptory cancellation of P.G.&E. contracts would cost the city $1,250,000 the first year and would result in an increase of 16 to 17 cents in the city's tax rate.

In asking for an extension of the March 1 deadline, city officials had previously disclosed that the Riverbank, Calif., aluminum plant, which purchased $2,400,000 worth of Hetch Hetchy power annually until its operations were suspended a few months ago, may reopen to engage in the manufacture of other war products. Should the Riverbank plant reopen, they stated, it again will be come a heavy purchaser of Hetch Hetchy power.

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Supreme Court Upholds Bonds of Springfield, Mo.

Issuance of $6,750,000 worth of revenue bonds by Springfield, Mo., to finance municipal ownership of gas, electric and transportation utilities has been upheld in a unanimous opinion of the Missouri supreme court.

The city contracted last September to buy all the common stock of the Springfield Gas & Electric Co. from the Federal Light & Traction Co. The circuit court upheld objections that the bonds were unconstitutional declaring the bonds invalid and enjoining the city from issuing them. But on the city's appeal, the high court declared, "We think it is clear that such cities are given authority to issue bonds payable only from income derived from any public utility to be acquired."

Drive to End War Time Begun by Representatives

Cannon and O'Hara Support Farmers' Viewpoint That Energy Saved at Day's End Is Required Early in Day—OWU Studying What Repeal Would Mean in Extra Capacity Requirements and Consumption

A new Congressional drive for the repeal of War Time was indicated this week when Reps. Clarence Cannon, Missouri Democrat, and Joseph P. O'Hara, Minnesota Republican, attacked WPB's position in favor of the measure with the statement that it could not prove that War Time has saved electricity.

Cannon and O'Hara, who led the fight against War Time last spring before a subcommittee of the House Interstate Commerce Committee, reiterated farmer opposition to War Time, with O'Hara insisting that energy saved at the day's end was required early in the day.

Cannon was quoted as saying that an Interstate Commerce subcommittee had unanimously voted for repeal, but a committee spokesman said no subcommittee on the matter had been organized since the death of the old subcommittee with the 78th Congress last December. The subcommittee last spring held numerous hearings but never completed them after OWU Director Edward Falck testified that War Time was indispensable, both from a capacity and fuel standpoint.

War Department Against Repeal

The Solid Fuels and Petroleum Administrations for War were strangely silent in the new controversy, but it was known that the War Department had opposed repeal on the basis that it would increase the consumption of fuel. Well informed government officials conceded that War Time, which was a capacity problem at its inception almost three years ago, is now as much of a fuel problem as a capacity problem.

Deputy Administrator Paul Valle of OWU's Power Division testified recently before the Michigan and South Dakota legislatures each of which was considering bills to circumvent War Time by changing the time zones applicable in their states. A bill putting Michigan in the Central Time zone rather than the Eastern zone was recently signed by the Michigan governor, but a similar bill was tabled by the South Dakota legislature after Valle's testimony. Valle may make a similar appearance before the Wisconsin legislature.

Meanwhile, Falck, has assigned OWU's statistical specialist, Constantine Bary, of the Philadelphia Electric Co., to a review of the War Time situation for new determinations of what repeal would mean in extra capacity requirements and extra kilowatt-hour consumption. While Bary's study is not yet complete, it was felt in some quarters that it would show some reduction in the 1,500,000-kw. capacity savings attributed to War Time in an earlier survey, but little if any change in the 1,600,000,000-kw.-hrs. estimated to be saved annually. It was felt that imposition of the "brownout" would be the principal cause of any reduction in capacity savings attributable to War Time.

V-E Day Will Bring No Relief

Several OWU officials indicated that the end of the German war will not afford the relief from War Time which it was generally felt a year ago would be forthcoming.

If the cutbacks cause only the cessation of third-shift operations, one official said, power systems would still be faced with morning and evening peaks, so that the capacity problem would be as important as ever. If, as seems unlikely now, cutbacks are as large as 40 percent, the figure commonly expressed last year, removal of second shift operations would cut the evening peak but leave the morning peak and its capacity problem.

While OWU men agree that in some areas the fuel and capacity problems are not so pressing as they are in many others, the value of many interconnections might be lost if easy areas were to revert to standard time. In any event, they add, it would be almost impossible to allow some areas to operate on standard time and hold less fortunate areas to War Time.

•

Utility Coal Consumption

Electric utility power plants consumed 7,351,329 tons of coal in December, 1944, the Federal Power Commission has reported. Coal stocks of electric utility power plants as of Jan. 1, 1945 were 8.5 percent more than stocks of the same date last year.

Utilities Rank Second on Coal Priority List

WPB Ratings Will Be Used only in Emergencies — No Distinction Made Between Group Members

Electric and other utilities rank second on an emergency coal priority list developed by WPB at the request of the Solid Fuels Administration for War. Existence of the list was disclosed by WPB Chairman J. A. Krug, who said that it will be used only in emergencies.

It was believed that the list, if it ever is invoked, will be invoked only on a local, or at the most, a regional basis, never nationally, Transportation tie-ups, such as those experienced recently when rail yards and lines became snowbound throughout the Northeast, might cause the list to be invoked for afflicted regions in which coal supply was low before the tie-up, one spokesman said.

Heading the list are industries which may require coal to prevent irreparable damage to equipment; i.e., coke ovens or blast furnaces which would be ruined if they were abruptly taken out of service when a coal pile gave out. No distinction is made as between less essential or more essential industries in this category, but impending damage to equipment must be demonstrable.

Transportation facilities, including ships requiring bunker fuel, and other utilities rate immediately behind this classification, again with no differentiation between members of this group. Domestic space heating requirements and industries follow, with industries classified according to essentiality. Seven categories of priority are established by the list, which was not made public.

Preparation of the list followed a request by SF Administrator Harold L. Ickes, who calculated that a 50,000,000-ton deficit in production would have to be faced this year. Of this deficit, 20,000,000 tons is anticipated to come from existing stockpiles. The remainder will have to be made up through savings. Ickes thus raised the deficit from the 25,000,000 tons anticipated by War Mobilization Director James F. Byrnes in his request for a "brownout" of nonessential lighting.

Electric utilities drew down their stockpiles substantially during January and the drain continued in February, running in some cases as high as 10 to 15 days per month. Some companies still have large stocks, but mere curtailment of purchases by these companies does not guarantee that the resulting free coal will find its way to those users most in need even though it does result in the availability of extra coal for allocation.

Eastern Financiers Enter Northwest Utility Fight

Guy C. Myers, New York "Financial Engineer," Offers to Purchase Puget Sound Power & Light Co. for Banking Syndicate—Eastern Washington P.U.D.'s Willing to Purchase Washington Water Power Co.

Eastern capital, represented by Guy C. Myers, New York "financial engineer", has entered the bitter public-private utility fight which has been in progress in the Pacific Northwest during the past two decades.

The fact that Eastern financiers have interested themselves in the prolonged campaign of the P.U.D.'s to take over the multi-million dollars worth of properties of the private-owned electric power concerns, operating in Washington and Oregon, was made known by Mr. Myers himself recently when he offered to purchase Puget Sound Power & Light Co., of Seattle, Wash.

In a communication to Frank McLaughlin, president of Puget Sound Power & Light, Mr. Myers stated he was acting for a New York banking syndicate, and that he was prepared to submit a "workable plan" for purchase of the company's electric system in behalf of the interests he represents. The banking syndicate, in turn, would resell the properties to the P.U.D.'s.

Myers also P.U.D. Agent

Meanwhile, Bernard Pearce, executive secretary of the Public Utility Districts' Information League in Washington, announced that Mr. Myers has also been authorized by eastern Washington P.U.D.'s to submit an offer for the purchase of Washington Water Power Co., of Spokane. This concern is owned by American Power & Light Co., of New York City.

American Power & Light was ordered recently by the Securities and Exchange Commission to disintegrate itself and to retain only integrated properties in contiguous territories. Nearly 100 percent of Washington Water Power common stock is reportedly held by American Power & Light and, as a consequence, any negotiations for purchase of Washington Power would, as a matter of necessity, be submitted to the New York office of the parent company.

For several years Mr. Myers has been more or less conspicuously indentified with efforts of the P.U.D.'s to acquire properties of the private-owned utilities in Washington and Oregon. However, his outright offer to act as "negotiator" for purchase of Puget Sound Power & Light for resale to the P.U.D.'s came as something akin to a breath-taker to many persons familiar with this modus operandi.

It was recalled that one of his most recent transactions was his negotiation of the sale of Nebraska Power Co. This deal subsequently resulted in a chaos of litigation.

In his letter to President McLaughlin of Puget Sound, Mr. Myers asked that fiscal data concerning the company's operations be made available to him. While Mr. McLaughlin acceded to this request, he emphasized that no purchase offer had been placed before him, that he hasn't "agreed to negotiate with anyone", and that nothing will be placed before the company's some 10,000 stockholders "until such time as a bona fide proposal has been submitted".

Meanwhile, members of the Washington legislature advocating public acquisition of private-owned utility properties in the state were prepared to initiate legislative action against the utilities if Mr. Myers' proposal is rejected.

The action, it was indicated, would take the form of a bill which would divide the state into three power authorities, empower P.U.D.'s to contract with organized labor and assure social benefits, render it mandatory for power companies to publish rates for P.U.D.'s obtaining a condemnation award and prohibit condemnation of municipal systems. Condemnation awards would be outlawed unless acted upon within a year.

MEETINGS

Northwest Electric Light & Power Association—Engineering and operation section, Davenport Hotel, Spokane, Wash., March 27-28. Berkeley Snow, executive secretary, 418 Spalding Bldg., Portland 4, Ore.

Previously Listed

Canadian Electrical Association — Annual western conference, Hotel Vancouver, Vancouver, B. C., March 14-16. B. C. Fairchild, managing director, 704 Tramways Bldg., Montreal 1, Que.

Electrochemical Society — Spring meeting, Hotel Claridge, Atlantic City, N. J., April 12-14. Colin G. Fink, secretary, Columbia University, 3000 Broadway, New York 27, N. Y.

Dominion Electric Power Bought by Saskatchewan

Negotiations have been completed by the Saskatchewan government for purchase of the entire controlling stock of the Dominion Electric Power, Ltd., of Estevan, at a cost of about $450,000, Provincial Resources Minister Phelps announced. The purchase is subject to ratification by the Saskatchewan legislature. Officials said it marked the first step by the government in a program of expansion of Saskatchewan power commission services.

Dominion Electric has properties which originally cost in excess of $3,000,000. It is one of the four large private utility companies in the province. Ultimate objective of the government is to have the power commission operating a province-wide system of power distribution. The company in addition to its Saskatchewan properties operates a plant in Manitoba, have plants in northern Alberta, and one in British Columbia.

The company will be continued as an operating unit until some plan has been decided upon in connection with the company's properties outside of Saskatchewan, Mr. Phelps said.

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Maui Electric Co. Needs Additional Plant Capacity

Maui Electric Co., Wailuku, Maui, Hawaii, has a critical power shortage because of increased sales to the armed services, W. K. Watkins, manager, reports.

The company is interested in securing 6,000 kw. plant capacity and a spare unit. The size of the units can vary from 2,500 to 7,500 kw. They should be turbo-generators, 60 cycle, 2,300 volt, 400 pound steam pressure, 750 deg. F. total temperature, 3 phase, and should have good efficiency with the associated condenser equipment and boiler as there is a load factor from 50 to 60 percent.

•

Apperson Remains Head of Virginia Commission

Harvey B. Apperson has been named chairman of the Virginia Corporation Commission for the year beginning February 1. The commission follows the rule of rotation in naming its chairman, each of the three members serving one year in the post. Apperson has been serving as chairman since last June when he was elected to fill the unexpired term of Thomas A. Ozlin who had died.

Illinois Power Will Build Power Station

Illinois Power Co. will begin work this fall on a new electric generating station on the east bank of the Illinois River near Havana, Ill., according to an announcement by H. E. Steinhoff, vice-president. Initial installation costing about $11,000,000 and consisting of two 40,000 kw. turbo-generator units is scheduled for completion by late 1946.

Plans for the complete project, involving an 8-year program, have not advanced sufficiently for an estimate of the total expenditure, it was explained. WPB approval of the company's application has cleared the way for the initial construction.

With completion of the major part of the project by 1950, the company will be rendered independent of outside sources of power to serve its northern and central divisions. Illinois Power has been buying part of its needs from Commonwealth Edison Co. and Central Illinois Light Co.

"The two 40,000 kw. units of the initial installation," Mr. Steinhoff states, "will use steam at 850 psi., 900 deg. supplied by three 285,000 lb. per hr. steam generators burning pulverized fuel. The plant substation," it was stated, "will consist of two 50,000 kva. 13.8/138-kv. transformers for supply to two 138-kv. transmission lines for interconnection with the existing transmission system."

•

'Let Us See', Lighting Film Released by I. E. Society

"Let Us See," an entirely non-commercial motion picture film designed to demonstrate the basic principles of good lighting under actual industrial conditions, has been released by the Illuminating Engineering Society, 51 Madison Avenue, New York City.

The film is a dramatization of the material comprising the "American Recommended Practice of Industrial Lighting" which was prepared by I. E. S. in 1942 and later adopted as a standard for industrial lighting by the American Standards Association and the Canadian Engineering Standards Association.

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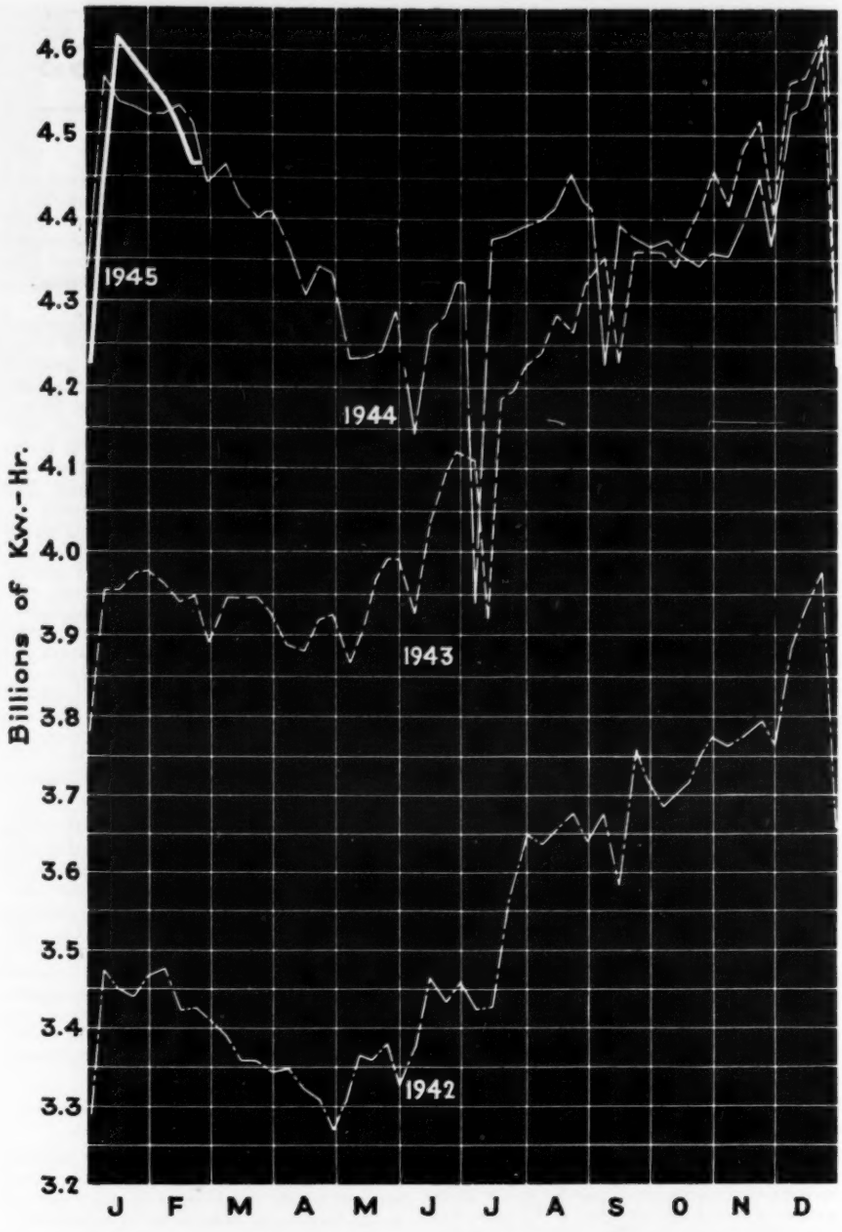
Will Better Ozark Service

Arkansas-Missouri Power Co. will spend $800,000 this year improving electric power service to towns throughout the Ozarks region, it was announced following the annual plan meeting of district managers and officials.



Electric Output Curve Turns Upward

Reversing the downward trend which set in in mid-January, the electric output curve during the week ended February 24, 1945, turned upward, according to figures released by the Edison Electric Institute. The amount of electrical energy distributed by the light and power industry totaled 4,473,962,000 kw.-hr., compared with 4,472,298,000 kw.-hr. during the preceding week. During the week ended February 26, 1944, energy distributed amounted to 4,444,939,000 kw.-hr., this year's figure representing an increase of 0.7 percent.

Only three of the seven major geographic regions reported decreases as compared with last year, the New England states joining the plus group with a 0.9 increase.

Weekly Output Millions Kw.-Hr.

1945		1944		1943	
Feb. 24	4,474	Feb. 26	4,445	Feb. 27	3,893
Feb. 17	4,472	Feb. 19	4,512	Feb. 20	3,949
Feb. 10	4,505	Feb. 12	4,533	Feb. 13	3,940
Feb. 3	4,539	Feb. 5	4,524	Feb. 6	3,960
Jan. 27	4,577	Jan. 29	4,524	Jan. 30	3,977
Jan. 20	4,588	Jan. 22	4,532	Jan. 23	3,974
Jan. 13	4,614	Jan. 15	4,539	Jan. 16	3,952
Jan. 6	4,427	Jan. 8	4,568	Jan. 9	3,953
1944		1943		1942	
Dec. 30	4,226	Jan. 1	4,337*	Jan. 2	3,780†
Dec. 23	4,617	Dec. 25	4,296	Dec. 26	3,656
Dec. 16	4,563	Dec. 18	4,613	Dec. 19	3,976
Dec. 9	4,538	Dec. 11	4,567	Dec. 12	3,938

* 1944 † 1943

Percent Change from Previous Year

	Week Ending		
	Feb. 24	Feb. 17	Feb. 10
New England	+ 0.9	— 0.0	— 1.9
Mid Atlantic	— 1.9	— 4.0	— 3.7
Central Industrial	+ 3.5	+ 1.5	+ 1.6
West Central	+ 8.8	+ 6.0	+ 9.2
Southern States	+ 6.9	+ 5.1	+ 4.9
Rocky Mountain	— 9.8	—11.9	—11.5
Pacific Coast	— 6.2	— 5.5	— 4.5
Total United States	+ 0.7	— 0.9	— 0.6

SEC DECISIONS—HEARINGS

The Securities and Exchange Commission, in a series of orders recently issued affecting electric utility companies:

APPROVED SALE of the outstanding securities of the Iowa-Nebraska Light & Power Co. by the Continental Gas & Electric Co. to the Central Electric & Gas Co. for $4,325,000. Iowa-Nebraska Light is a subsidiary of Continental Gas. Central Electric is an operating utility and not a subsidiary of any company. Central Electric, after it acquires the 33,684 shares of common stock of Iowa-Nebraska Light, will become parent of the latter. However, it proposes to acquire immediately all the properties and assets of Iowa-Nebraska Light, to assume all its liabilities and to dissolve it. Iowa-Nebraska Light will declare and pay to Continental Gas, prior to the sale, a cash dividend of $465,000 out of paid-in surplus. Continental Gas is an intermediate holding company in the United Light & Railways and United Light & Power Co. holding company system. The commission reserved jurisdiction over use of the proceeds of the sale by Continental Gas.

HAS AUTHORIZED Central & South West Utilities Co. to retain four major electric utility subsidiaries as a single integrated system. They are the Public Service Co. of Oklahoma, Southwestern Gas & Electric Co., West Texas Utilities Co. and Central Power & Light Co., operating in Texas, Oklahoma, Arkansas and Louisiana. The company was ordered to dispose of its interests in: Central Power's water properties and all of its non-utility operations in the Texas "Big Bend" district; West Vernon Sewer Co.; water distribution properties of West Texas and its ice properties in Dalhart; Public Service Co. of Oklahoma's water properties and all of its natural gas properties except those needed for electric generating purposes; water and ice properties of Southwestern Gas and Peoples Ice Co. The order provided, however, that with respect to Peoples Ice Co. and the ice properties of Southwestern Gas & Electric Co. "and only respecting these items" the order shall become effective thirty days from February 16, 1945.

APPROVED PROPOSAL of Northern States Power Co. of Wisconsin to acquire the steam heating business of the Willow River Power Co., a Wisconsin corporation, for $840,000, subject to closing adjustments. The Public Service Commission of Wisconsin and the Federal Power Commission have approved the acquisition.

APPROVED APPLICATION filed by the Northern Pennsylvania Power Co., a subsidiary of the NY PA NJ Utilities Co., covering the sale of $4,000,000 of first mortgage bonds maturing on Jan. 1, 1975, and requesting exemption for the issue from competitive bidding requirements of the Holding Company Act. Part of the proceeds from the sale are to be used to redeem outstanding bonds.

CONDITIONALLY APPROVED two plans of the Standard Power & Light Corp. and the Standard Gas & Electric Co. Under the first plan, filed jointly by parent and subsidiary, all assets of Standard Power, the parent, would be converted into new common stock issued by Standard Gas, the subsidiary, and would be distributed to claimants of Standard Power, which would be dissolved. Both plans are contingent upon approval of the U. S. District Court of Delaware and also upon that court's now pending decision on the recapitalization plan of the Standard Gas. The joint plan provides that Standard Power transfer to Standard Gas all of its holdings of the latter's securities and all other assets; that in exchange, Standard Gas issue and deliver to Standard Power 567,581 shares, or 11 percent of its new common stock, and that the Federal Court of Delaware dismiss Daniel O. Hasting's pending suit against Standard Power. The second or dissolution plan, advanced by Standard Power, calls for distribution of the 567,581 shares of new common stock of Standard Gas as follows: (1) 14½ shares, plus all unpaid dividends, for each preferred share, or 86.99 percent of the shares to be distributed; (2) 4.8 of the new shares for each 100 shares of common stock, or 11.17 percent of the stock to be distributed; (3) 4.8 new shares for each 100 common shares, Series B, or 0.93 percent; and (4) 5,158 shares, representing 0.91 percent, to H. M. Byllesby & Co., Chicago, in settlement of the Homewood litigation against Standard Power.

AT REQUEST of Cities Service Power & Light Co. extended to March 15 the time within which the holding company shall dispose of its entire interest in its subsidiary, City Light & Traction Co., Sedalia, Mo., to Missouri Public Service Co. The sale was authorized by the commission on Aug. 1, 1944, subject to its being consummated within sixty days. The commission has since granted several extensions of time in order to permit the purchaser to obtain the necessary authorizations from regulatory agencies other than the SEC.

Applications Filed

CITIES SERVICE CO. has filed an application for authority to increase the aggregate amount of its investments in securities of, and advances to certain of its subsidiaries, at its discretion, to the extent of $12,000,000. Such investments are to be in addition to any permitted by rule U-3 B-15 under the Holding Company Act.

OGDEN CORP. has filed a registration statement, covering the proposed issuance of 2,165,296 shares of $4 par value common stock of a subsidiary, the Laclede Gas Light Co. The stock will be offered by Ogden at competitive bidding. Laclede has also filed, covering this stock.

FLORIDA POWER CORP. has requested authority to sell for a base price of $1,210,000 all its real estate, physical facilities and local franchises relating to the manufacture and distribution of gas in Orlando, Winter Park, Sanford, Orange City, Maitland and Deland, Fla. to the Florida Utilities Corp. The proposed sale would be to comply with SEC orders requiring Florida Power to divest itself of certain specified assets, including gas properties by July 14, 1945.

CENTRAL OHIO LIGHT & POWER Co., Findlay, Ohio, has asked for approval of the payment in April of a dividend of $2.50 a common share out of earned surplus. The dividend would absorb $50,000, leaving an estimated earned surplus of $432,500 as of June 30.

Hearings Scheduled

MARCH 7: On proposal of Western Light & Telephone Co. to merge into its subsidiary, Kansas Power Co., the surviving corporation to be known as Western Light & Telephone Co., Inc.

MARCH 8: On amended plan of Great Lakes Utilities Co.

UTILITY REPORTS

	Net Income 1944	1943
*American Gas & Electric and subs	‡$12,089,136	$11,683,831
*Cleveland Electric Illuminating	5,901,886	6,114,111
*Idaho Power	1,406,143	1,225,852
*Iowa Public Service	650,019	670,076
*Pennsylvania Water & Power	2,159,069	2,114,697
*Puget Sound Power & Light and subs	5,144,933	5,398,242
*Sioux City Gas & Electric	665,422	654,571
	1945	1944
†Commonwealth & Southern and subs	$11,523,445	$12,323,220

* Twelve months ended December 31.
† Twelve months ended January 31.
‡ Preliminary.

Water Association Acts to Block Pine Flat Dam

Moving to thwart a Bureau of Reclamation program for construction of the $19,000,000 Pine Flat Dam for flood control on Kings River, near Fresno, Calif., the Kings River Water Association announced early in February it has filed application with the Federal Power Commission for a license to develop its own hydroelectric project on the river.

Vigorously opposing the Bureau's plan for Kings River development, the water association, composed of 19 irrigation districts taking water from the river, are seeking the right to develop a $34,000,000 project which would provide 115,000 hp. at peak efficiency 90 percent of the time, it was reported.

The already authorized dam at Pine Flat would be part of the association's proposed project of three appurtenant dams, four power plants and connecting tunnels. Speedy action is being sought so as to tie up available power sites in conjunction with Pine Flat Dam, Philip Conley, attorney for association, was quoted as stating.

Application for right to use irrigation water for power development was filed at the same time with the California Division of Water Resources, it was announced.

Power would be used for irrigation, industrial and domestic service within the area and irrigation units participating would be direct beneficiaries, according to the filing.

HOW

DESIGN · CONSTRUCT · OPERATE · MAINTAIN

Delta Systems Grounded through High Resistance

By A. A. JOHNSON

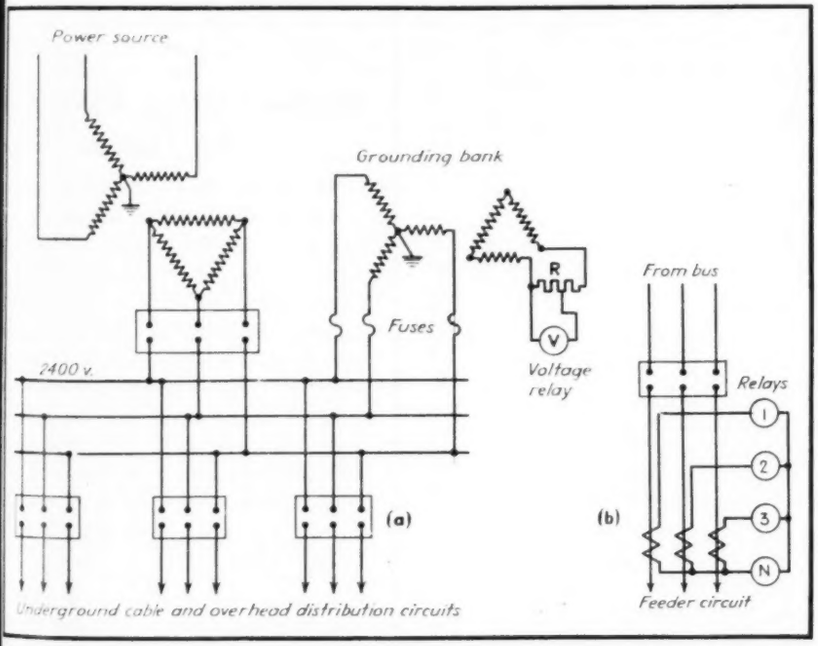
Central Station Engineer, Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

The 2,400-volt bus (Fig. a) is grounded through a resistance by means of three single-phase distribution transformers. The 2,400-volt transformer windings are wye-connected with the neutral solidly grounded. The resistance is placed in one corner of the delta-connected secondary and in effect is a high resistance placed in the primary neutral. The resistor is a low-ohm, relatively low-current device, is rugged physically and low in cost. A current flows through the resistor only during line to ground faults on the system. The resistor loss is made equal to or greater than the distributed capacitive kva. of all three phases of the system to ground.

This grounding device provides resistance loss to limit transient voltages which may be caused by arcing grounds or arcing across circuit breaker contacts. In this manner all circuit and equipment insulation is protected from high peak voltages and simultaneous ground faults are reduced to a minimum. The voltage across the resistor or part of the resistor may also be used for ground fault indication by providing a voltage relay as shown.

As an example consider a 2,400-volt bus having several distribution circuits composed of underground cable and overhead conductors as well as direct circuits supplying 2,400-volt synchronous and induction motors. The capacitive ohms for all circuits and motors per phase to ground was calculated to be 710 ohms, which for the line to ground voltage of 1,380 volts gives 1.95 amp. This is 2.69 kva. per phase or 8.07 kva. for three phases. The loss in the resistor, therefore, should be at least 8.07 kw. during line to ground faults. Using distribution transformers of 2,400 to 240 volts, the voltage across the resistor during a line to ground fault will be a maximum of (240) ($\sqrt{3}$) or 416 volts. Dividing 8.07 kw. by 416 volts the resistor must be rated for a maximum of 19.5 amp. The resistance of the resistor must be 416 divided by 19.5 or 21.3 ohms which in effect is 236 ohms connected between the transformer neutral and ground.

The primary windings of the transformers must be rated for 1.95 amp. Thus the kva. of each of the three transformers is (1.95) (2.4) or 4.7, which requires a 5 kva. standard distribution transformer of continuous rating. The current through the neutral of the transformers is 3 (1.95) or 5.85 amp.



RESISTOR IN DELTA (a) of wye-delta grounding bank is equivalent of higher resistance in primary neutral. Ground faults readily relayed (b) on feeders

Several Applications

This scheme of grounding ungrounded systems has been applied in several cases on 2,400-volt buses and is recommended for use on buses through 13.8 kv.

By applying equipment which will allow sufficient ground current to flow, relaying for ground faults (Fig. b.) may be applied to distribution circuits. Using the above example, if ground relaying is desired, three 15-kva., 2,400 to 240-volt distribution transformers could be used

which would provide a maximum continuous ground current through the transformer neutral of 18.75 amp. for faults close to the bus. In order not to overload the transformers, the secondary resistor must have a resistance of 6.67 ohms and carry 62.5 amp. The 6.67 ohms in the delta is equivalent to 74 ohms connected directly to the primary neutral. Thus a fault on the end of a distribution circuit will still allow a large part of the 18.75 amp. to flow because circuit resistance is small compared to the 74 ohms. Fault resistance will be involved also but should not cause fault current in this case to be reduced to less than 10 amp.

• • •

"As Found—As Left" Maintenance Form

By CHARLES KIEL,
Supt. of Generating Plant, Queens Borough Gas & Electric Co., Far Rockaway, N. Y.

Elimination of "paper work" in station maintenance is something that is always sought. Often in this process the details of maintenance are overlooked. To conform to the objectives, the illustrated form has been devised.

Details of "as found" and "as left" are entered on the form simultaneously with the discovery and correction of the defect. Upon completion of the overhaul the forms are filed for later reference. With this type of information accumulated over a period of years it is relatively easy to pick out the weak points in the equipment, the repairs effected, and the case history of all the equipment in the station.

Similar forms are filled out for all component parts of the boiler and its auxiliaries. These include:

Superheater: Tubes; finger plates; hangers and supports; headers.
Baffles: Tile; flame plates.
Drum: Steam baffles; incoming feed water; Tubes: Dry, wet and slag tubes.
Tube Headers: Front and rear headers.
Boiler Setting: Brickwork; casing and doors.
Furnace Tubes: Water wall, circulating and hopper tubes.
Water Wall Headers; Top, intermediate and bottom.
Furnace Blocks: Front and rear walls; right and left side walls.
Ash Hopper: Lining; ash gates; ash gate frame; hopper frame.
Air Preheater: Tubes and sheet; casing and seal; hopper bottom; gates and tail piping.
Forced Draft Fan: Buckets and stay rock; balance; housing; bearings and couplings.
Induced Draft Fan: Buckets and stay rock; balance; housing; bearings and couplings.
Breeching: From I.D. fan to flue; bypass; short flue; main flue.
Dust Collector System: Cyclones and piping; elements; fans; dampers and tank.
Soot Blowers: Elements; valve heads; hangers.
Dampers: I.D. fan; F.D. fan; main and duct; by pass; stack.
Valves: Non-return; safety; blowdown; stets regulators.
Smoot Control:
Meters—Gages: Steam flow; feed water; water columns; draft and pressure gages.
Air System: Duct air—F.D.; duct primary air; feed lines and valves; stack.
No. 3 Unit: Oil Coolers Nos. 1 and 2; air general cooler; condenser; condensate lines and valves; atmosphere lines and valves; Dean control; Hotwell control; Chapman valves Nos. 1 and 2; Chapman valve dividing; boiler feed No. 1; 11th stage heater; gland heater; 7th stage heater; surge tank; condensate pumps Nos. 1 and 2; 11th stage drainer pumps; smoot pumps.
Turbine No. 3: (a) Inspect hood and last wheel, (b) Complete external inspection, (c) Repairs effected, (d) Inspect hydraulic packing, (e) Inspect throttle packing, (f) Check overspeed, (g) Drain oil, clean reservoir and renew oil, (h) Check rocker arm.

Form #557

QUEENS BOROUGH GAS & ELECTRIC COMPANY Sheet No.

Generating Station - Far Rockaway, N. Y.

Maintenance Schedule Week _____

Boiler #7 Overhaul - Meters - Gauges

Equipment	Remarks	Signed
Steam Flow	DISMANTLED, CLEANED & RE-ASSEMBLED	
(a) As found	WATER COLUMN TEST APPLIED & PUT BACK IN SERVICE	
	METER & ACCESSORIES FOUND IN GOOD CONDITION. MERCURY LEVEL CHECKED O.K.	
(b) As left	METER TESTED & CALIBRATED TO WITHIN ¼ OF 1%	
Feed Water	FEED WATER GAUGE IN BOILER ROOM CHECKED & RE-CALIBRATED	
(a) As found	READING 3 POUNDS HIGH OVER ENTIRE SCALE	
(b) As left	RE-CALIBRATED TO CORRECT PRESSURE	
Water Columns	(a) OK	
(a) As found		
(b) As left	(b) packing added	
Draft & Pressure Gages	DRAFT GAUGES INSPECTED, CHECKED & PIPING CLEANED. RECALIBRATED WHERE NECESSARY	
(a) As found	FOUND CORRECT EXCEPT PREHEATER OUTLET	
(b) As left	ALL DRAFT GAUGES CORRECT	

MAINTENANCE SCHEDULE FORM with typical remarks. This 8½ by 11-in. form is made out for the meters and gages on No. 7 boiler

•

Welder's Drops Developed for "Flash" Burns

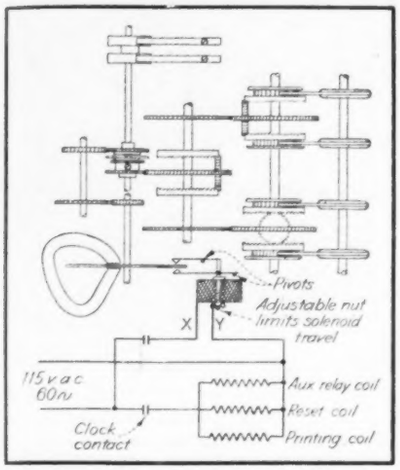
An outstanding source of eye injuries in shipyards and similar industries, according to K. A. Koerber (*Am. J. Surgery* 63:192, 1944), is "flash" burns or actinic conjunctivitis caused primarily by the ultra-violet rays produced when the welder strikes his arc. The eye condition gives rise to a series of unpleasant symptoms, and is suitably treated in the clinic. For home use, each welder with this ailment receives a quarter-ounce bottle of a specially prepared "Welder's Drops" made from:

Pontocaine	0.25 percent
Ephedrine sulfate	0.25 percent
Menthol	0.10 percent
Glycerine	5.00 percent
Boric acid solution, to make	100.00 percent

More Accurate Demand Record Made Possible

By JOSEPH R. TOOMEY.
Chief Electrician
Blackstone Valley Gas & Electric Co.
Woonsocket, R. I.

Errors in demand readings at Riverside Station have been overcome by an auxiliary device of our own design. The kilowatts delivered are totalized for simultaneous demand by a group of watthour meters equipped with contacts that transmit impulses representing blocks of kilowatt-hours



SCHEMATIC DIAGRAM of totalizing meter relay showing position of device which makes possible the capturing of previously lost impulses. The relay coil is connected in parallel with the printing and reset coils. Thus the relay coil is energized at the same instant that the demand is printed and drops out three seconds later; this allows the printing wheel sufficient time to reset from the maximum forward position

to a summation relay which spaces the impulses at one second intervals for delivery to the printing-type demand meter.

As a check on the operation the outgoing impulses from the summation relay are counted by a six-digit cyclometer and the impulses received by the demand meter are counted by another cyclometer. The figures recorded by these cyclometers for any specific period should be in agreement with each other and should equal the sum of the figures printed on the demand meter tape for the same period. It was found, however, that the figure on the tape was always less than that recorded by the cyclometers. This shortage at times amounted to 2,500 kw.-hr. per day. (Kw.-hr. obtained by multiplying the impulse constant by the figure on the cyclometer or printed on the tape.)

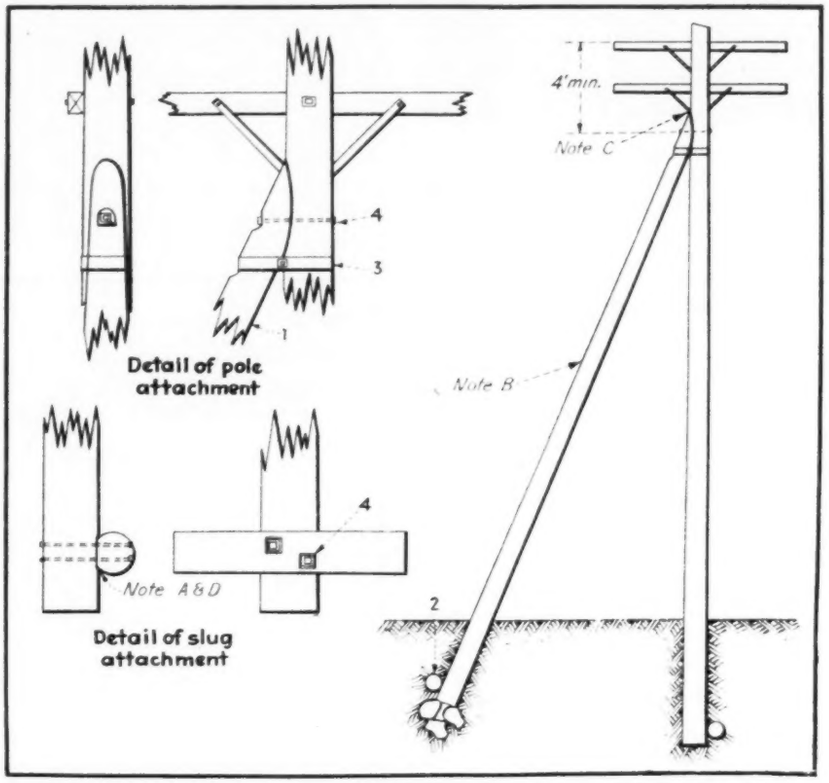
A study of the equipment in operation revealed that the impulses not recorded on the tape were lost during the time that the printing wheel was resetting. This resetting time varies with the number of impulses received during the demand period —at normal load this is approximately 2½ seconds. Any impulse sent during this period will not be recorded on the tape.

The previously mentioned device enables the totalizer to withhold and store impulses while the printing wheel is resetting by taking advantage of the compressibility of the spring drive between the input summation gears and the output contact-drive shaft. A pair of levers (discarded relay contacts) at the proper instant grasp the disk of the summation relay to prevent rotation. Thus the summation gears continue in motion in response to incoming impulses and wind up the spring of the spring coupling with increasing tension. When the resetting has been completed the disk is again freed and the stored energy in the spring propels the shaft forward by an amount equal to the stored impulses. In this way the contacts are closed to send the same number of impulses which were received from the watthour meters while the totalizer was blocked.

Very little force is required to oppose the disk's torque. Equal pressure on both top and bottom of the disk results in no undue wear on shaft pivots and bearings. The levers are moved by a small solenoid which is energized by a relay with instantaneous closing and time delay opening contacts.

• • •

Push Brace Set-Up Is Standardized



STANDARD POLE BRACING INSTALLATION with attachment details for overhead construction, with provision for pine slugs when specified, has been established by United Illuminating Co., New Haven and Bridgeport, Conn. Simplification of design and minimum use of material feature the layout

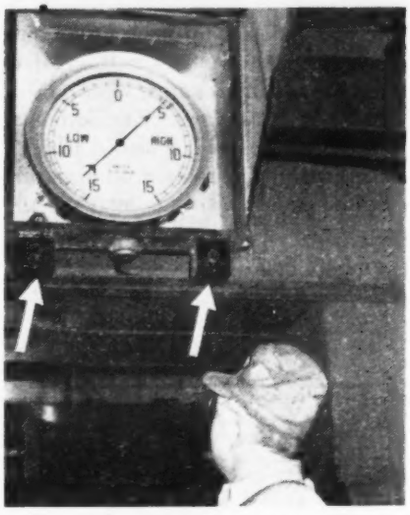
List of material: (1) one pine pole; (2) two pine slugs, see Note D; (3) one pole band; (4) five ⅝-in. machine bolts (length as required), each with two square washers

Notes applying are: (A) slab gain base of pole and slug; (B) in general use same length push brace as line pole; (C) top of push brace should be as near to load center as possible; (D) to be used when specified

Impulse Signal Lamps Warn of Load Changes

By C. S. ROADHOUSE
Nebraska Power Co.
Omaha, Nebraska

Red and green signal lights that flash in accord with "raise" and "lower" impulses of the load control telemetering system at the Omaha Steam Plant of Nebraska Power Co. have been installed in the boiler room to give operators advance warning of load changes that will increase or decrease steam demands.



RED AND GREEN signal lamps in boiler room of Omaha generating station flash in accordance with the "raise" and "lower" impulses of load control telemetering equipment that acts on turbine governor. Lamps give operator advance warning of pending changes in steam demand

Raise and lower impulses originate at a remote system dispatching point and are brought into this station to regulate turbine governor positions in accordance with demands of the interconnected system for more or less generation. Control impulses come through at two second intervals. Duration of each impulse is proportional to the rate of change of load in either direction. Longest possible impulse duration, however, is one second.

There is sufficient time lag between a series of similar control impulses and the actual turbine reaction to make knowledge of their direction, number and duration useful to boiler operators in adjusting steam generation to pending demand. Until recently, however, visual indication of the nature of the impulses was confined to two rather inconspicuous lamps on a recording instrument panel in the station control room.

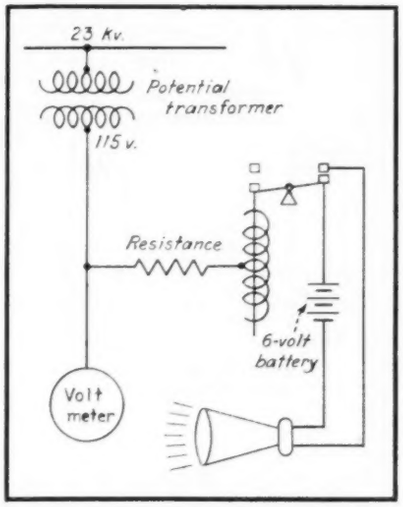
All that was necessary to extend other impulse indicating lamps to various useful points in the station was to arrange existing telephone voltage relays in the impulse circuits to operate auxiliary relays to energize either of the two lamps from 110 volts in accordance with the nature of the telemetering control impulses.

Red indicating lamps have been used throughout the station to indicate "raise" impulses; green for "lower" impulses. Sets of two lamps have been installed above the bench board in the station control room and at two points in the boiler room. Accompanying picture show typical installation.

•

No-Voltage Alarm for Substation Use

In substations where the lone attendant is often away from the control board on inspections or to perform minor maintenance tasks some form of no-voltage alarm is a "must". One such alarm made of a part of type TS130 General Electric contact making voltmeter, a battery and a horn has been devised by A. R. Kassner, Superintendent of power production, Patchogue Electric Light Co., Patchogue, L. I., N. Y.



SINGLE-LINE DRAWING of substation no-voltage audible alarm

The plunger is held up as long as the bus is energized. Should the bus lose its potential the plunger drops down and closes the battery switch. The alarm sounds to call the attendant back to the board.

Reel Brake Eliminates Manual Braking

A back-lash reel brake has been devised that eliminates the arduous task of manually braking the reel during pulling-in operations.

This simple but effective tool was made in the shops of the Philadelphia Electric Co. of regularly stocked materials. The accompanying illustration clearly shows the details. One improvement has since been added. The tie wire has been replaced by a 6-in.

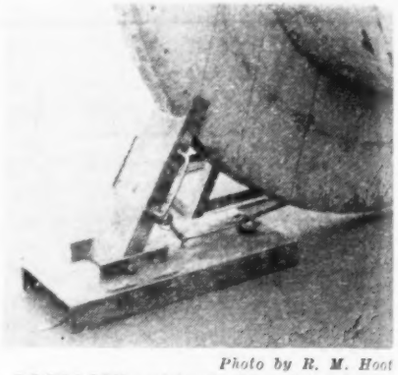


Photo by R. M. Hoot

BACK-LASH reel brake has 10-in. channel base. Ears are 2-in. angle-iron. The 15½-in. chock is made of 5-in. channel iron and is hinge-hung to the ears by a ⅜-in. bolt

(1¾-in. O.D.) spring to operate the wheel chock.

The brake is tied to the reel jack. This is necessary because it was found that the brake would not stay in position from its own weight and slippage would take place.

•

Vertical Cable Runs Need Support

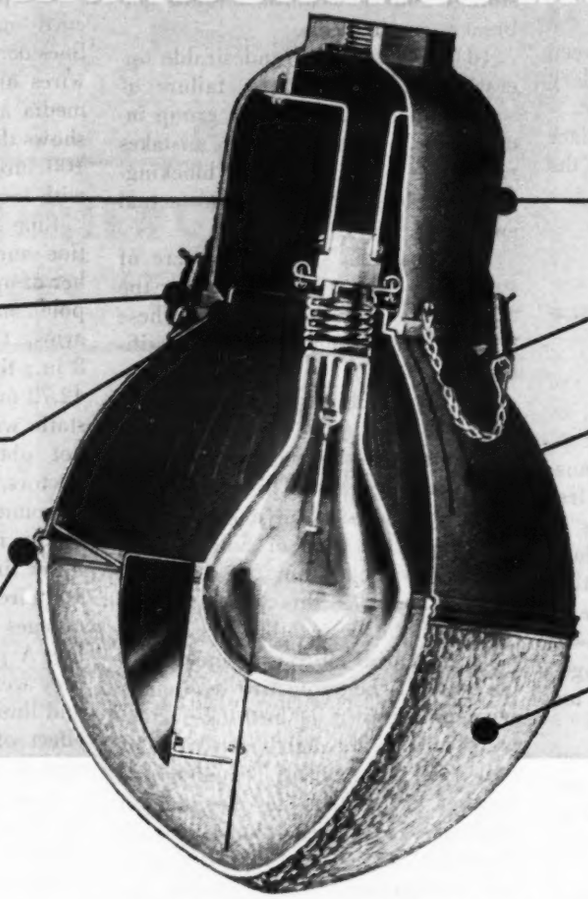
By GEORGE I. SMITH
Switchboard Operator, Minnesota Power & Light Co., Duluth, Minn.

There are times when lead-covered cable in conduit runs are not anchored, due perhaps to the assumption that friction between the cable and conduit is sufficient to hold the cable in place. One experience indicates the desirability of anchoring.

For several months there was an intermittent ground indication on our 130-volt d.c. control system, usually just a flicker of the ground indicating lamps when one of the 14-kv. OCB's was operated. Eventually it came on as a continuous "partial" or high-resistance ground. Also the bell-alarm annunciator indicated the presence

NOVALUX

HOW FORM 79 LUMINAIRES reduce maintenance man-hours



Heavy-duty sockets and receptacles, firmly mounted, assure permanence of focus.

Toggle latches provide easy access to interior.

Machined joint excludes weather, dirt, and insects. No gasket to replace.

Permanently sealed assembly keeps interior clean, avoids chipping of globe edge, practically eliminates glassware breakage.

Aluminum—strong, durable, nonrusting. Needs no painting.

Suspension chain frees both hands during relamping, to prevent dropping reflector.

Flutes prevent heat concentration on lamp stem—prolong lamp life.

Holophane refractor or rippled globe—tough, long-life pressed glass. If breakage does occur, fully reconditioned reflector with new glassware is available through G.E.'s low-cost exchange plan.

Besides reducing your maintenance budget, Form 79 luminaires give you the advantages of low initial cost, unexcelled lighting efficiency and attractive, modern appearance.

Form 79 luminaires are again available in their prewar aluminum construction—with hoods, insulators, and reflectors for any style of mounting and any desired light distribution. G-E street-lighting specialists will help you apply them to best advantage or plan a comprehensive modernization program for the future. *General Electric Company, Schenectady 5, N. Y.*

Are you tieing-in with the NEMA Plan to give America better street lighting?

Buffalo plans to relight for safety

With the co-operation of G-E engineers, the city of Buffalo, N. Y., has completed a comprehensive analysis of its traffic-accident areas and has made postwar plans to modernize its street lighting. This improvement is expected to save 33 lives annually, and prevent more than 1000 injuries and nearly 5000 cases of property damage.

GOOD STREET LIGHTING BUILDS GOOD WILL

Buy all the BONDS you can—*and keep all you buy*

GENERAL ELECTRIC

of alternating current in the bell-drop solenoid. After a couple of hours trying to locate the source of the a.c. voltage, a 14-kv. bus-tie OCB was opened and the ground lamps showed clear. Tracing the various cable from the OCB auxiliary switches led us to a pull-box recess in a concrete wall in the sub-basement. Here a vertical cable, branching to two horizontal runs, had slipped down about six inches and two conductors rubbing by vibration on the concrete floor of the pull-box had worn through the insulation, allowing contact between a potential transformer secondary lead and a d.c. lead to a pilot light.

We pulled the cable back to place and put a clamp around it at the upper end of the conduit.

•

'E' for Excellent Relay Performance

By A. FRANK AYRES
Protection Engineer
California Electric Power Co.
Riverside, Calif.

Whenever an undesirable interruption takes place on an electrical transmission or distribution system, frequently the first hand reaction is to blame some relay for not having done its duty properly. If other operating companies' results are comparable to those of the California Electric Power Co., these diligent relay "watchdogs" undoubtedly receive considerable unfair criticism.

A study of the protective relay operations of this company for the past 11-yr. period disclosed the startling fact that relays failed in line of duty in less than one-half of 1 percent of the cases of automatic breaker operation. This does not indicate that 99½ percent of all operations were desirable. The actual over-all accuracy figure which included relay, control circuit, breaker and mechanism averaged 94.3 percent for the period.

An analysis of the protective equipment failures during this period indicated the following:

(a) 30 percent of the undesirable operations were caused by lack of proper protective facilities. In some instances this may have been due to an unusual condition which could not respond to any standard protective relay. In other instances, relay equipment could be applied, but conditions had not made such an installation economically feasible.

(b) 26 percent of failures took place during the period immediately following installation before final adjustments had been completed. This rather large group indicates that actual installations do not always coincide with theoretical calculations so far as relay action is concerned.

(c) 17 percent of faulty operations were directly due to failure of related equipment entirely external to the relays. This includes such items as storage batteries, control circuits and breaker mechanisms.

(d) 10 percent of undesirable operations were caused by failure of some human element. This group includes many varieties of mistakes ranging from trip-circuit blocking-switches being left open to actual switching errors.

(e) 9 percent of failures were of such nature that exact reason for the action could not be determined. These remain listed in an unknown classification.

(f) The remaining 8 percent of undesirable operations were considered as failures of the relays themselves for various reasons. This undesirable 8 percent is less than one-half of 1 percent of the total of both correct and incorrect operations.

Experience of this company has indicated the desirability of making occasional over-all tests to include all portions of the protective equipment from the primary of bushing current transformers, through secondary circuits, relays, control circuits and breaker mechanism to the breaker contacts. In general, after one such thorough inspection, the next one or two maintenance tests involve the relay equipment only. At least two regular tests are made of all relay equipment each year. In addition, many special tests are made at the time of new installations, when making setting changes or occasionally following an undesirable operation.

The operating record outlined above offers sufficient inducement to view protective relay action with properly deserved admiration.

•

Data Confirms Worth of Lightning Protection

By J. S. MALOY
Chief Engineer of Lines
West Penn Power Co., Pittsburgh, Pa.

Comparison of operating experience on four 132-kv. single-circuit lines demonstrates the value of ground wires and counterpoise as protective media against lightning. Table below shows the decrease in line outages per 100 circuit miles on the four lines with increasing degrees of protection.

Line A, which has the least protection and, naturally, the largest number of operations, is of H-frame wood-pole construction with 28-ft. fir crossarms. Conductor spacings are 13 ft. 8 in.; there are no static wires on its 42.72 mile of length. Line B has two static wires but complete coverage is not obtained for the outside conductors. It also has a limited amount of counterpoise. With that protection on this its 58.8 mi. single-circuit steel-tower line, outages were cut to 9.1 per 100 circuit-miles per year. Lightning outages on line B were 4.0 while on line A per 100 circuit miles per year they were 33.2. The two static wires and limited counterpoise thus had the effect of reducing the lightning outages 88 percent.

Line C, which has two static wires so arranged as to give complete coverage to all conductors, plus counterpoise where necessary, did not have a single lightning outage. All outages on this 29.96 mi. single-circuit steel-tower line resulted from disturbances originating on other lines. Line D is 44.92 mi. in length and is of the same design as Line C. It has had no outages except two flukes which occurred shortly after being energized.

Interruptions per 100 Circuit-Miles per Year

Cause	Line A H-Frame wood No static wire No counterpoise	Line B Steel towers 2 static wires Limited counterpoise	Line C Steel towers 2 static wires Counterpoise	Line D Steel towers 2 static wires Counterpoise
Lightning	33.2	4.0	.0	0
Wind and sleet	.1	.5	.0	0
Other mechanical causes	.4	.0	.0	0
Originated elsewhere	2.2	.8	3.3	0
Miscellaneous and unknown	8.6	3.8	.0	0 *
Totals	44.5	9.1	3.3	.0

* Two interruptions, caused by shot-wire hanging on crossarms, occurred on this line shortly after it was placed in operation.

—low-pressure gas-filled cable for 10 to 40-kv service will be comparable in economy with solid-type insulated cable, with the added advantage of self-supervision

—A.I.E.E. Transactions—1939

G-E STUDIES FORECAST IT

FIELD EXPERIENCE CONFIRMS IT

More than 250,000 feet of gas-filled cable (10 to 40 kv) now operating. More installations planned

EVERY installation of G-E low-pressure gas-filled cable has proved the accuracy of that forecast. Installations considered experimental when made by utilities five years ago are now accepted as setting the pattern for many of their future cable runs. To date, there has been no cable failure, no insulation deterioration. Gas-filled cable and solid-type insulated cable ***are*** comparable in economy, but gas-filled cable offers not only self-supervision in addition, but other advantages as well.

SELF-SUPERVISING *Plus*

In addition to the self-supervision feature, which guards it against failure following sheath damage, gas-filled cable has the ability to withstand overloads with a greater margin of safety. Ionization is self-extinguishing, even at levels of voltage stress higher than normal working-voltage stresses.

EASY TO INSTALL

With gas-filled cable, profile of the installation is no longer a problem, because there is so little compound migration. Joints can be made with essentially the same technique as for solid-type cable. A simple nitrogen-gas cylinder, equipped with valve and pressure relay, maintains gas pressure in runs up to 40,000 feet.

For further information on low-pressure gas-filled cable, ask for Bulletin GEA-3652. *General Electric Company, Schenectady 5, N. Y.*

RATINGS: Low-pressure, 10 to 40 kv; Medium-pressure, 40 to 69 kv

GAS-FILLED CABLE

GENERAL ELECTRIC

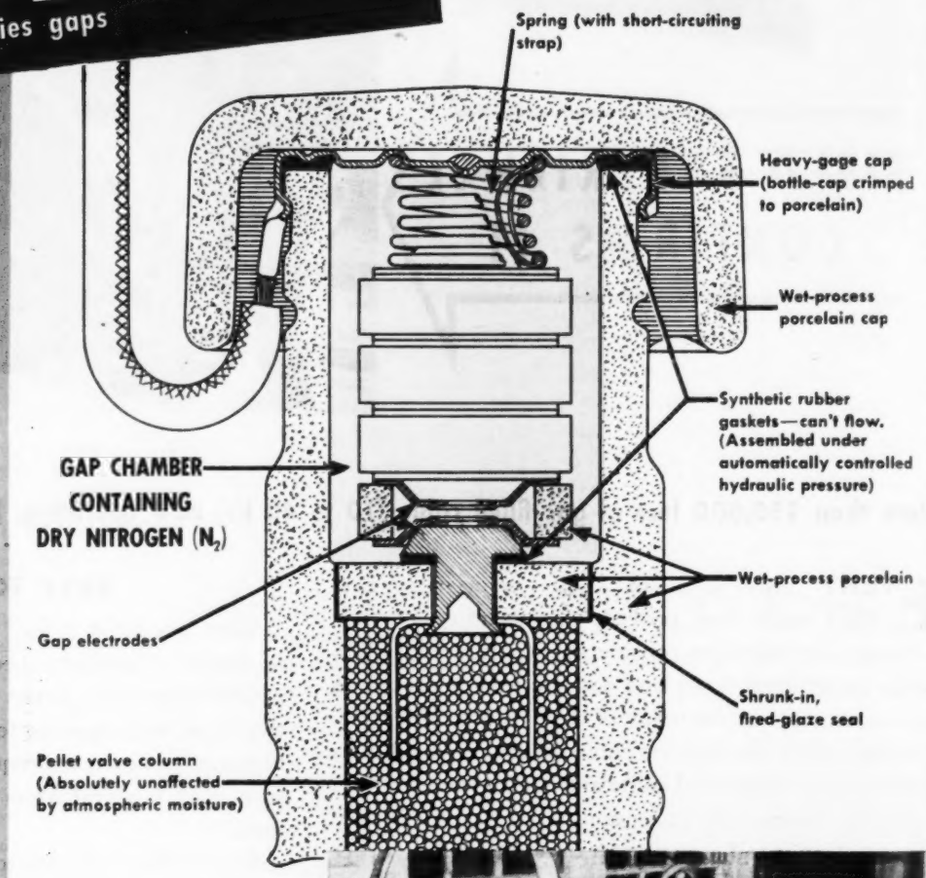
501-26-1200

Buy all the BONDS you can—*and keep all you buy*

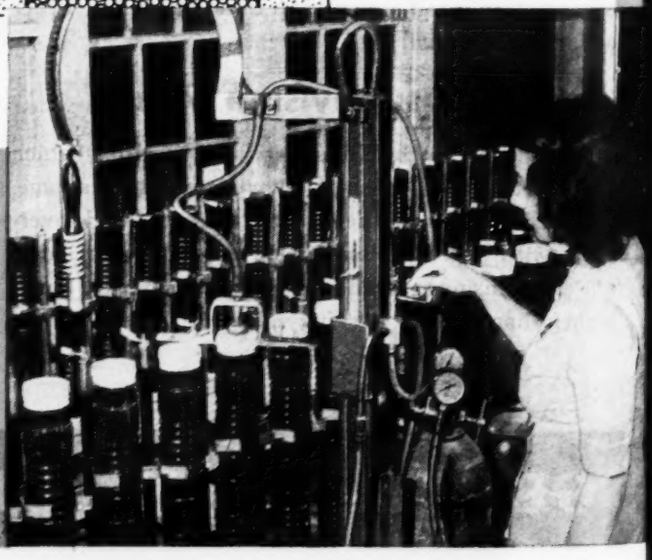
The G-E PELLET ARRESTER...a leader

N_2-FILLED GAP CHAMBER assures

The G-E pellet arrester is the only distribution lightning arrester that has a separately sealed gap chamber—the only construction adapted to N_2-treated series gaps


Spring (with short-circuiting strap)
Heavy-gage cap (bottle-cap crimped to porcelain)
Wet-process porcelain cap
Synthetic rubber gaskets—can't flow. (Assembled under automatically controlled hydraulic pressure)
GAP CHAMBER CONTAINING DRY NITROGEN (N_2)
Wet-process porcelain
Gap electrodes
Shrunk-in, fired-glaze seal
Pellet valve column (Absolutely unaffected by atmospheric moisture)

Sectional construction of 9-kv pellet arrester, typical of other ratings, showing separately sealed N_2-filled gap chamber containing series gaps.



A section, of the pellet arrester assembly line, showing the station for evacuating, vacuum testing, injecting nitrogen, and final sealing.

PELLET ARRESTERS

since 1922... now even better

a new high in reliability

This major improvement, the latest of many refinements introduced during the past twenty years, offers these exclusive features:

1. All air and atmospheric moisture (usually sealed in the arrester with *ordinary* manufacturing methods) are completely evacuated from the gap chamber.

   This positively excludes the moisture of normal atmospheric humidity from the series gaps of the arrester, thus eliminating the recognized adverse effects of internal condensation ("dewing") caused by changes in outdoor temperature.

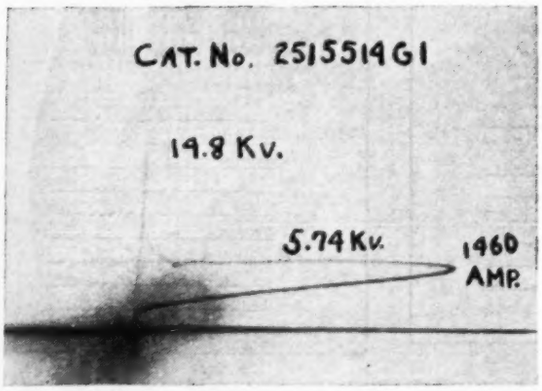
2. A vacuum test assures tightness of gasket seals.

   The evacuation of air and moisture provides an error-proof, routine, vacuum-withstand test of the main sealing of each arrester. Thus, any unit having the slightest leak is detected and rejected.

3. Dry nitrogen (N_2) is injected into the gap chamber, and the small "treating" hole in the metal cap is immediately solder-sealed.

   The injected dry-nitrogen permanently sealed in the gap chamber is *inert*. It prevents the formation of any ozone or oxides; keeps the gap electrodes bright as new during years of service operation, and gives more stable gap-sparkover characteristics.

The N_2-filled gap chamber is a distinctive advance that assures even greater service reliability of G-E pellet arresters, which have always been distinguished by the following outstanding characteristics:



The excellent impulse protective characteristics of pellet arresters *stay excellent*. Here is an oscillogram of a 3-kv pellet arrester after 18 years of continuous service operation. The arrester was manufactured in 1924.

1. Low impulse breakdown voltage to start discharge.

2. Exceptionally low IR drop, even at high discharge currents.

3. Large discharge capacity for severe lightning strokes.

4. Valve action; no exposed live parts or arc flame. Pellet arresters can be used on *any* part of *any* distribution system, rural or urban.

Ask for Bulletin GEA-2975 for complete information on G-E pellet arresters. *General Electric Company, Schenectady 5, N. Y.*

GENERAL ELECTRIC

POLYPHASE WATTHOUR METER CONNECTIONS FOR TOTALIZING 3-WIRE CIRCUITS

By W. H. BRUCE, Engineer, Department of Water and Power, City of Los Angeles, Calif.

Diagrams show connections for 3-phase, 3-element, single-disk, Sangamo meters with test switch and test block for total measurement of energy in the designated circuits. Plus (+) sign indicates polarity. These connection diagrams have been adapted from electrical standards of Department of Water and Power, City of Los Angeles.

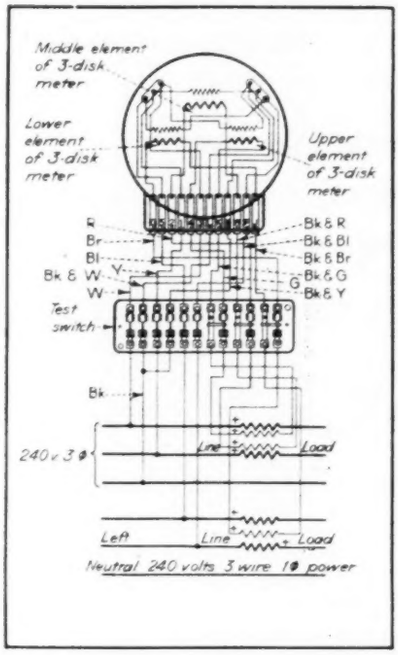


Fig. 1—Meter connections for 3-wire, 3-phase and 3-wire, single-phase power circuits

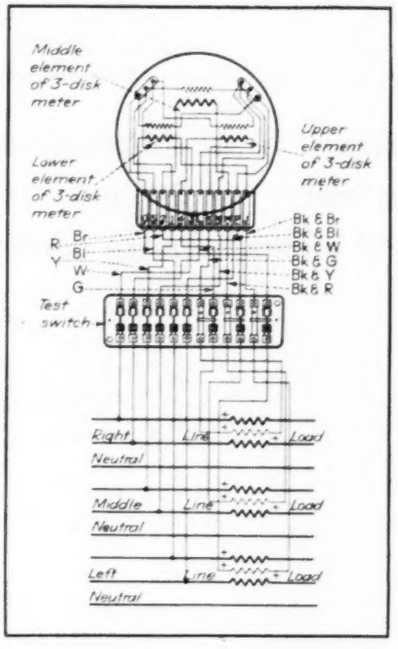


Fig. 2—Meter connections for three 3-wire lighting circuits, with No. 3 test switch

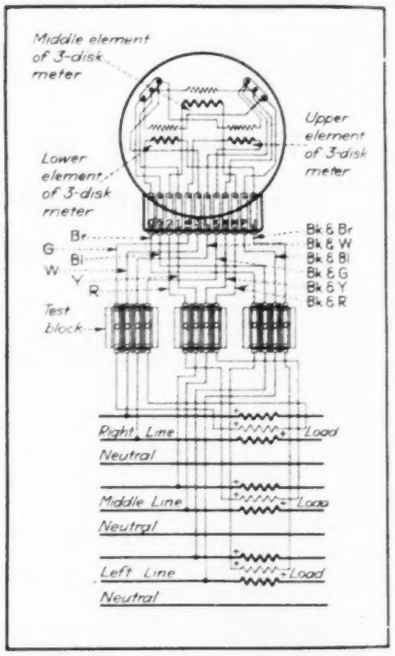


Fig. 3—Meter connections for three 3-wire lighting circuits, with No. 5 test block

Color Legend

Bk. for Black	Br. for Brown	W. for White
Bl. " Blue	G. " Green	y. " Yellow
	R. " Red	

In shipyards portable electric cables and cords must be tough

TIREX SELENIUM Rubber Armor

Simplex-TIREX - 3 Conductor Cable
Type W

Type W - without ground wires.
Type G - with ground wires,
Type SH-A-without ground wires, shielding over each conductor.
Type SH-C - without ground wires, shielding over cabled conductors.
Type SH-C - with ground wires, shielding over cabled conductors.
Type SH-D - with ground wires, shielding over each conductor.

Simplex-TIREX, the original rubber-sheathed cable, was specially designed for hard service with portable electric equipment. It is extensively used in shipyards, mines, quarries, industrial plants and wherever flexible cables carry current to portable electric equipment. There is a size and type to meet every requirement and performance records accumulated during the past twenty-five years prove that no better cable can be had for such service.

The smaller cords are suitable for drills, riveters and other tools; larger cables are specially designed for welders, shovels and the heavier machines; all have flexible conductors, high grade insulation and the selenium rubber armor that has become a distinguishing feature of Simplex-TIREX because of its toughness and resistance to abrasion.

Your flexible electric cables or cords should always be selected to fit the machine or tool that will depend upon them for current. The type of work to be performed and any unusual exposure to wear and tear should be kept in mind. Conductors of proper size with adequate insulation and protection from mechanical injury are essential. When you are selecting cords or cables to meet your operating conditions our experience can be of value to you.

Buna S has replaced natural rubber in Simplex rubber insulations and jackets.

Simplex Wire & Cable Co., 79 Sidney Street, Cambridge 39, Mass.

ARMY (E) NAVY

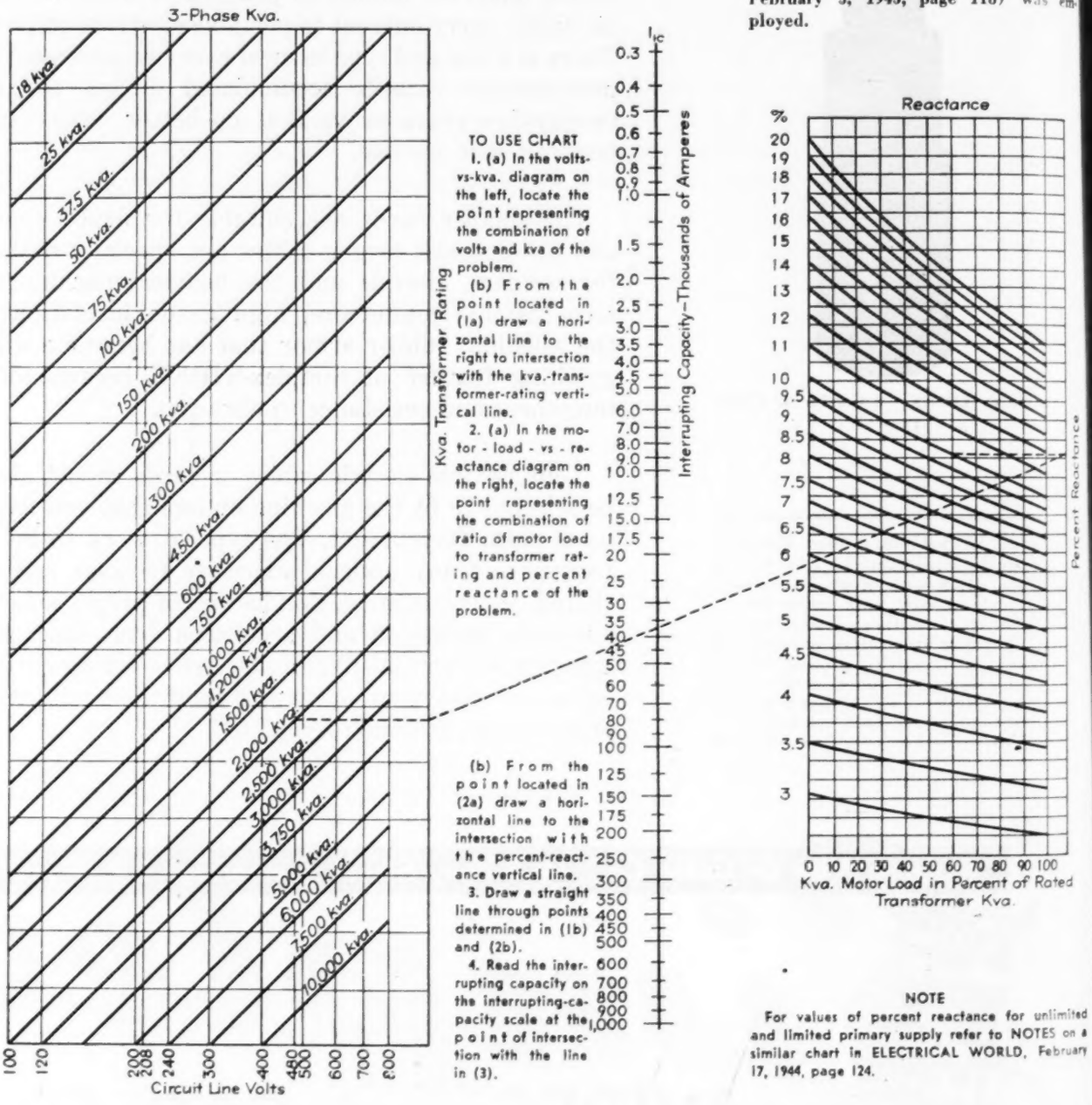
Simplex WIRES and CABLES

CHART FOR DETERMINING INTERRUPTING CAPACITY OF LOW-VOLTAGE AIR CIRCUIT BREAKERS

By WILLIAM DEANS, Chief Engineer, I-T-E Circuit Breaker Co., Philadelphia, Pa.

Chart may be applied for any voltage and for any ratio of motor load to transformer rating. Current contributed by the motors to the interrupting capacity is considered five times the motor full load current.

This chart is more general in application and includes the specific conditions of another chart for the same purpose (ELECTRICAL WORLD, February 17, 1945, page 124). For both charts the same basic development (ELECTRICAL WORLD, February 3, 1945, page 118) was employed.



TO USE CHART

1. (a) In the volts-vs-kva. diagram on the left, locate the point representing the combination of volts and kva of the problem.

(b) From the point located in (1a) draw a horizontal line to the right to intersection with the kva.-transformer-rating vertical line.

2. (a) In the motor - load - vs - reactance diagram on the right, locate the point representing the combination of ratio of motor load to transformer rating and percent reactance of the problem.

(b) From the point located in (2a) draw a horizontal line to the intersection with the percent-reactance vertical line.

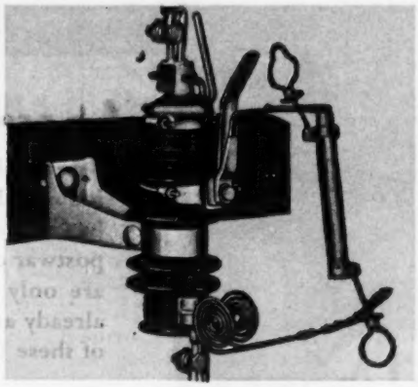
3. Draw a straight line through points determined in (1b) and (2b).

4. Read the interrupting capacity on the interrupting-capacity scale at the point of intersection with the line in (3).

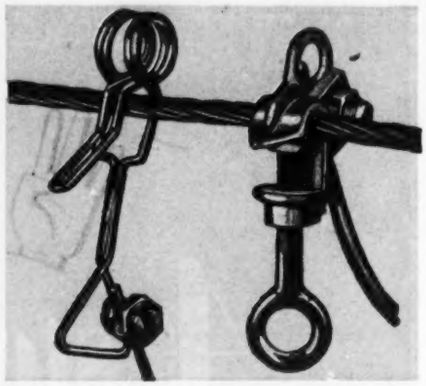
NOTE

For values of percent reactance for unlimited and limited primary supply refer to NOTES on a similar chart in ELECTRICAL WORLD, February 17, 1944, page 124.

LOW MASS, extra-flexible switch parts mean high resistance to mechanical shock and heavy short-circuit rupturing capacity.



LIGHTNING STROKES dissipated through low resistance path to ground. Power follow-up interrupted within the horn fibre fuse tubes.



CLAMPS. There is a Kearney Con-nec-tap clamp for the most unusual load or construction problem. Made in many types for all wire sizes.

ELIMINATE CHARRED CARTRIDGES

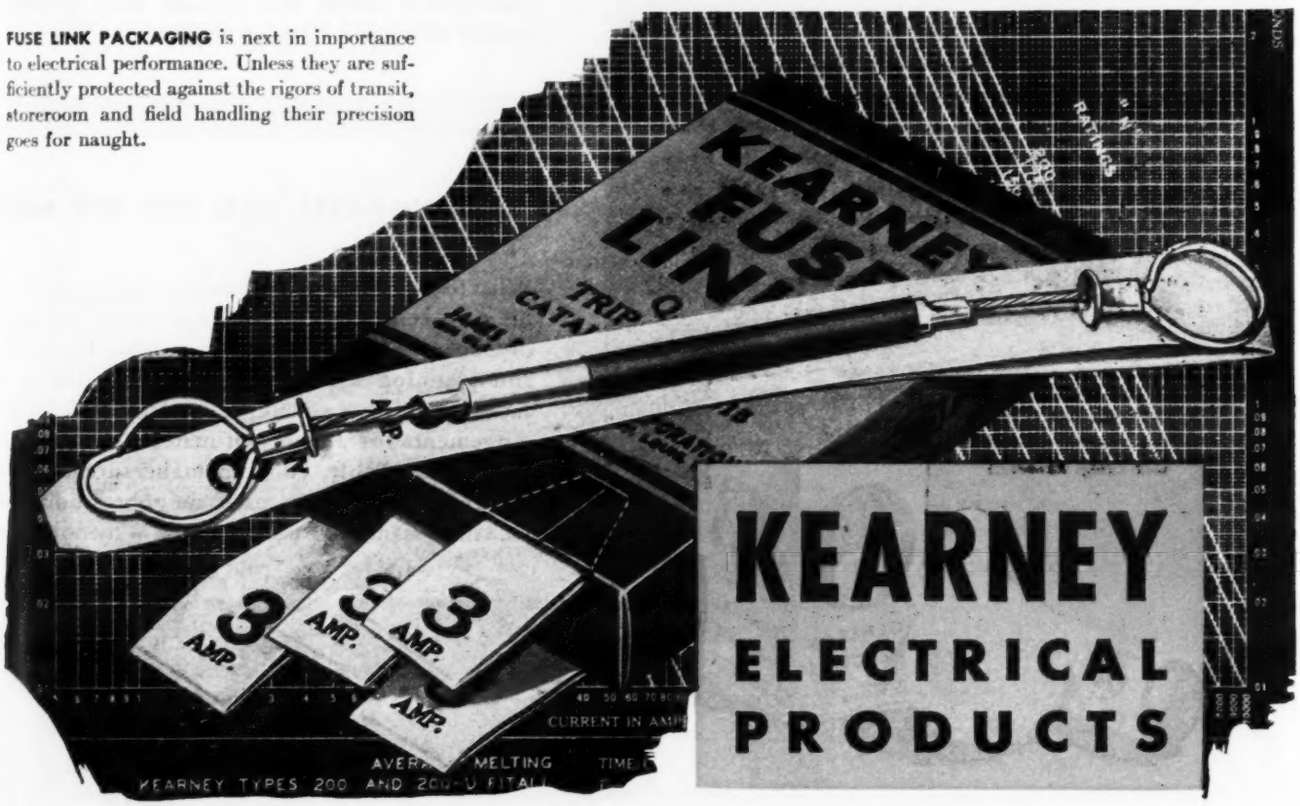
All Kearney fuse links are designed to operate at full load well below the charring point of fibre —the material used as a liner in all cutout cartridges. You may have had failures of cutout cartridges on heavily loaded lines, but not if you are using Kearney fuse links. Or, your cutout cartridges may be operating on the ragged edge where there is not enough heat to cause actual charring, but quite enough to desiccate the tube to the point where the rupturing capacity of the cutout is greatly impaired.

In easier days when lines and fuse links were carrying only a fraction of their rated loads the temperature margin of safety was sufficient. With today's loads you are inviting certain trouble unless you know the operating temperature of your fuse links and cutouts at full load current. If you haven't investigated ask your supplier for this information or better still change to Kearney—the fuselinks with the low temperature characteristic. Your inquiry on this subject will be welcomed by Dept. "H."

JAMES R. KEARNEY CORPORATION,
4236 Clayton Ave., St. Louis 10, Missouri

LOW TEMPERATURE — POSITIVE — INTERCHANGEABLE

FUSE LINK PACKAGING is next in importance to electrical performance. Unless they are sufficiently protected against the rigors of transit, storeroom and field handling their precision goes for naught.



KEARNEY
ELECTRICAL
PRODUCTS

4 steps to Better Postwar Commercial Lighting

The prior claims of war production are a necessary limitation on all activities looking to the development of postwar markets. Within these limitations, which all of us recognize, the lighting industry has an obligation to prepare now for its share in the task of stimulating postwar business activity and providing postwar jobs. Commercial lighting will be the spark—hence the program outlined on these pages.

"To make G-E lamps STAY BRIGHTER LONGER" The constant aim of G-E lamp engineers

1 G-E SPONSORS NEW LIGHTING IDEAS

Several of the nation's outstanding architects and industrial designers have been commissioned by G-E to suggest creative new lighting ideas for postwar commercial establishments. Their ideas are only suggestions but fixture manufacturers already are at work on new designs to put many of these ideas into practical fixtures.

2 G-E PROMOTES NEW LIGHTING MARKETS

G-E Lamp advertising covers practically all your postwar commercial lighting markets — with horizontal coverage in general magazines such as Time, Newsweek, Business Week and U. S. News, and vertical coverage in thirty-nine other publications that reach special fields—everything from banks to beauty shops, and groceries to garages.

3 G-E DEVELOPS NEW LAMPS

New G-E Mazda Fluorescent Lamps will make higher standards of store lighting easier to sell. More than ever before the lighting of the postwar store will say "Come in and Buy!" New G-E Fluorescent Lamps will include both slimmer, longer tubes and circular shapes.

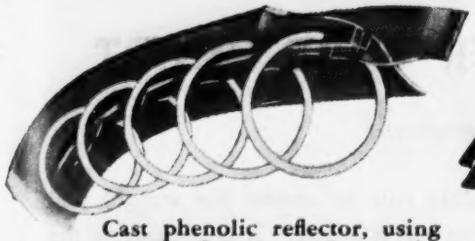
4 G-E SUGGESTS YOU TRY THE NEST EGG PLAN

What the merchant sees in other stores influences his own relighting plans. That fact is the basis of General Electric's "nest egg" plan. By selling and planning a model lighting installation in each shopping area NOW, and by making arrangements for delivery of materials as soon as they are available, you can make sure that the *first* relighting job in each neighborhood will set a high standard for all the rest. Why not try it?

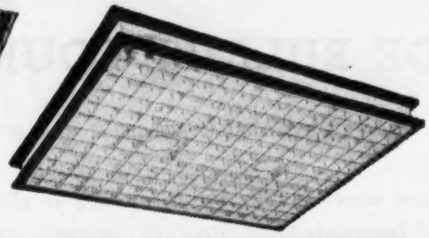
BUY WAR BONDS AND HOLD THEM

G-E MAZDA LAMPS

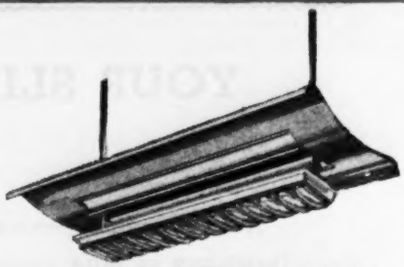
Hear the G-E radio program "The G-E All-Girl Orchestra" Tuesday 10:00 p.m.



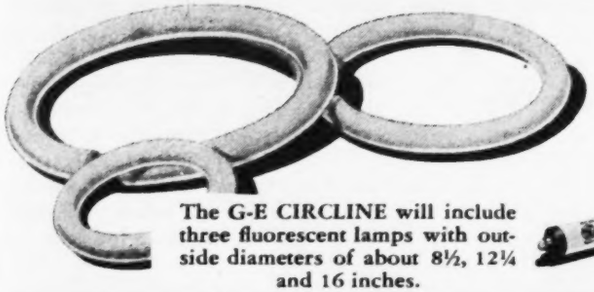
Cast phenolic reflector, using circular fluorescent lamps, designed to direct store traffic.



Fluorescent unit with adjustable spotlights for highlighting displays.



Four-lamp fluorescent luminaire suggested for grocery store.



The G-E CIRCLINE will include three fluorescent lamps with outside diameters of about 8½, 12¼ and 16 inches.

The G-E SLIMLINE—four new slimmer fluorescent lamps up to eight feet in length.

FIRST: Sell the nest eggs NOW. Show the storeowner the advantages of being *first* in his neighborhood to relight and explain how you will help him. Bring a contractor and supplier in on the job.

SECOND: Make a complete layout, covering general, showcase, display and decorative lighting, both incandescent and fluorescent. Order all the materials NOW, for delivery when conditions permit.

THIRD: Expedite the installations. Your nest eggs will get off to a head start—and you'll have in each shopping area a practical example of first-rate lighting that will set the pace for all. Try it!

GENERAL ELECTRIC

EWT, NBC, "The World Today" news, Monday through Friday 6:45 p. m. EWT; CBS, "The G-E Musicpolitan," Monday through Friday 4:45 p. m. EWT, CBS.

YOUR SLIDE RULE IS YOUR WIRE CHART

By PHILIP MORRILL, Windham, New Hampshire

Accompanying procedure was developed for using a slide rule to obtain the weight and resistance of bare copper (annealed, 20 deg. C.) wire in any AWG size. It is similar to the method for determining the area and diameter, as presented in an article, "How to Remember the Wire Table," in ELECTRICAL WORLD, November 27, 1943, page 84. Exemplification of wire characteristics calculated by slide rule are shown in the table. Values found are approximate but of sufficient accuracy for all purposes except laboratory work.

Area—Circular Mills

This section is a resumé of the previous article. The slide of the slide rule is inverted so that the large numbers on the L scale are opposite the small numbers on the D scale, as in Fig. 1. On some rules the numbers on the L scale will appear upside down.

Move the slide until the 10 on the L scale is at 1.04 on the D scale, and hold this setting. Each number on the L scale becomes an AWG wire size and using the glass indicator the opposite reading on the D scale is the circular mil value. Thus, 10 on the L scale is wire size No. 10 AWG and the corresponding reading on the D scale is 10,400 circular mils. Values for wire sizes from No. 10 to No. 1 may be read at this indicator setting.

Use the digits 10, 9, 8, 7 on the L scale to correspond to 1/0, 2/0, 3/0 and 4/0 sizes; then opposite digit 10 or size 1/0 on the L scale read 104,000 circular mils on the D scale. For sizes smaller than No. 10 each set of figures on the L scale becomes a group of ten wire sizes. No. 20—No. 11 is one decimal place smaller than corresponding No. 10—No. 1 sizes. No. 20 is 1,040 cir. mil; No. 30 is 104 cir. mil; No. 40 is 10.4 cir. mil. and No. 50 is 1.04 cir. mil. These values are approximations, which are close enough for practical purposes, but not exact. Accuracy may be increased by setting the slide at 1.055 for 1/0—4/0 sizes and at 1.02 for No. 20—No. 11 sizes.

Diameter—Inches

To determine the diameter in inches of any wire, take the square root of the circular mil value as found in the preceding section and divide by 1000. Read the circular mils on the A scale and with the glass indicator for a guide read the value opposite on the D scale, see Fig. 2. Point off three places smaller and the result is the diameter in inches. No. 10 AWG, 10,400 cir. mil is 0.102 inches in diameter.

Resistance—Ohms per 1,000 Ft.

To determine the resistance of copper wire the slide of the slide rule is inserted so that in normal position low figures on the L scale are opposite low figures on the D scale, as in Fig. 3. Set zero on the L scale at 1.04 on the D scale. Figures on the L scale are now AWG sizes and values on the D scale are resistances in ohms per thousand feet of copper wire. No. 10 AWG has a resistance of 1.04 ohms per thousand feet.

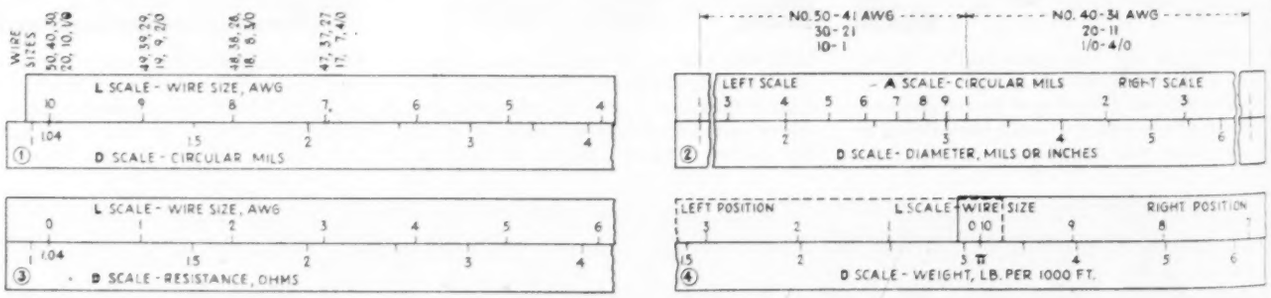
Weight—Pounds per 1,000 Ft.

To determine the weight of bare copper wire, the slide is inserted in the rule reversed as in method for finding circular mils so that 10 on the L scale is set opposite 3.14 (or π) on the D scale, as in Fig. 4. Reading is as before. No. 10 AWG bare copper wire weighs 31.4 lb. per thousand feet. As half of the slide will extend beyond the end of the D scale, it will be necessary for lower values of wire sizes to reset the slide so 0 (zero) on the L scale is opposite 3.14 of the D scale. All wire sizes may be read as before by shifting decimal point one place for each group of ten sizes.

Examples of Copper Wire Characteristics Determined by Slide Rule Settings

Wire Sizes, AWG	Area, circular mils: set 10 on L scale opp. 1.04 on D scale	Diameter, inches: set cir. mils on A scale read dia. (in.) on D scale	Resistance, ohms/1,000 ft.: set zero on L scale opp. 1.04 on D scale	Weight, lb./1,000 ft.: set 10 on L scale opp. 3.14 on D scale
1/0	104,000.	0.322 (R)*	0.104	314.
10	10,400.	0.102 (L)*	1.04	31.4
20	1,040.	0.0322 (R)	10.4	3.14
30	104.	0.0102 (L)	104.	0.314
40	10.4	0.00322 (R)	1040.	0.0314

* Values from (R) right-hand and (L) left-hand section of A scale.



SLIDE RULE settings for determining characteristics of copper wire. Fig. 1 for area in circular mils; Fig. 2 for diameter in inches or mils; Fig. 3 for resistance in ohms; Fig. 4 for weight in pounds per thousand feet (bare wire).

Because of the basic importance of adequate wiring to the entire electrical industry, Anaconda is presenting messages like this in a wide list of national publications.

A PRIZE POSTWAR KITCHEN—

see that it works!

Don't handicap your electrified home of the future with wiring of the past...

TELEGRAM WIRE TELEGRAM AHEAD

Automatic housekeeping! It's a *must* for postwar homes. Refrigerator and electric range of course. Dishwasher—garbage disposer—washing machine—ironer. Exhaust fan—innumerable appliances.

They are all necessary. But don't ruin their operation by inadequate electrical wiring. To run your equipment *right*—you *must* have proper wiring.

What's the capacity of your electrical circuits? Will it make the grade with future additional equipment?

Too often postwar electrical wiring plans based on *past* experience lack *reserve* capacity to meet the huge future increase in electrical demands.

Manufacturers! This subject is as important in the factory as in the home. Industrial wiring plans too must anticipate future power loads out of all proportion to past formulas.

Obviously unplanned wiring, expensive alterations, will be more costly than planned wiring. Now—while you're in the blueprint stage—is the time to consult electrical contractor—utility power engineer. They too will advise: Wire Ahead! 44359

ANACONDA

ANACONDA WIRE & CABLE COMPANY

25 Broadway, New York City 4... Sales Offices in Principal Cities

Method of Stripping Formex Wire

A simple method of stripping heavy Formex wire by dipping the ends into two solutions and stroking between the thumb and forefinger has recently been devised by George Rattray, chief engineer of the Fairchild Camera & Instrument Corp., New York City. The new patented method was developed specifically to avoid the effects of (1) embrittlement of the metal in the wire from high temperatures, (2) charring and hardening of the synthetic resin adjacent to the stripped section, and (3) dissolving away the copper wire in the hot solder stripping-tinning operation. Also the method was to be simple, speedy and require a minimum of handling.

Two materials are used in the process. Material A serves as a starter. Material B is the accelerator and can be one of several substances comprising a solvent for material A. Heat is used as an accelerating factor, with all temperatures under 500 deg. F. So far as is known, it is not harmful in any way to the operator.

Wire to be stripped is put through the following procedure:

(1) Dipped to the desired depth in hot (425–450 deg. F.) liquid material "A" for five to ten seconds which is the time required to complete the starting action. (Time varies with temperature and freshness of bath.)

2. Dipped immediately to a slightly greater depth and for approximately the same length of time into a colorless liquid "B" which is maintained at 120–140 deg. F.

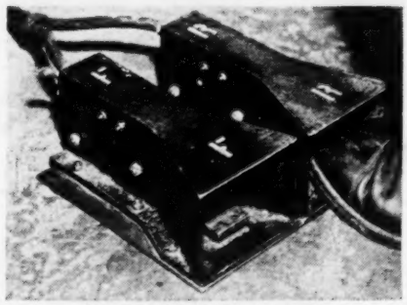
3. Upon removal from material "B", the wire is stroked gently between the thumb and finger to remove the softened Formex.

The stripped wire is now ready to be tinned. Thus, all tinning and stripping operations are carried on at relatively low temperature. The method is not reversible; that is, the materials A and B cannot be used in reversed sequence with good results.

•

Foot-Switch Designed for Toe Operation

A foot switch built with the operating pedal very close to the floor level permits the operator to keep both feet firmly on the ground and to actuate the switch with his toes. This style



SWITCH operated by toe pressure

of switch, as shown in the illustration, was developed by the Tool Design Electrical Group of the Glenn L. Martin Co., Baltimore, Md. It was designed originally for a Farnham roll forming machine and is used in large quantities in the company's manufacturing operations.

The electrical mechanism consists merely of a standard micro-operated switch which is quite accurate in movement and requires low pressure and travel to operate.

All moving parts of the switch are supported on ball bearings to reduce friction and wear. These same parts are balanced dynamically so that sudden shocks or movements will not produce undesired operation.

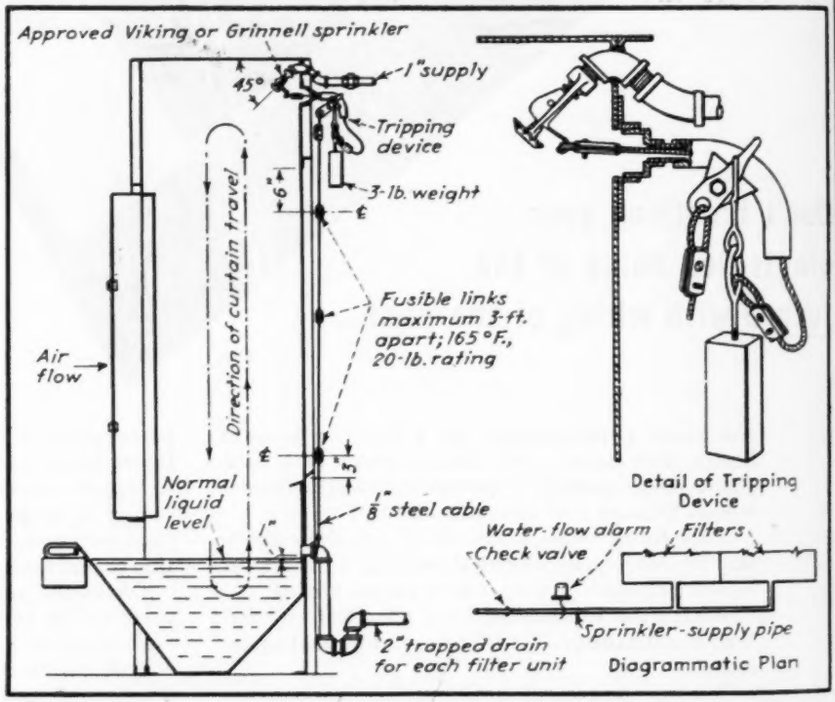
Housing of the switch has an integral safety cover made of heavy gage welded steel plate to prevent undesired or accidental operation. Being extremely rugged it will withstand severe abuse.

A foot switch comprises two pedal-operated units, one for "forward" and other for "reverse" motor operation. Release of toe pressure on either pedal opens the control circuit for stopping the motor. The switches are suitable for 110-volt circuits as that is the highest control voltage used on machine tools in the Martin company plant.

•

Fireproofing Air Filters

Two recent fires in electromatic air filters used in connection with air conditioning systems showed that fire damage was reduced to 2.5 percent of the loss in the first case when filters were equipped with automatic sprinklers. These filters are arranged so that dust particles on entering become electrically charged and are attracted to filter plates of opposite polarity. The closely spaced plates pass in and out of an oil bath, which covers them and removes the deposited dust. The inspection department of the Associated Factory Mutual Fire Insurance Companies, Boston, Mass., has made up a plan for equipping both



OUTLINE OF AIR FILTER showing arrangement of sprinkler equipment. Waterflow alarm is arranged to shut off the fan and sound alarm. A check valve is provided in main sprinkler supply for each group of filters. Fill sprinkler supply piping with non-freeze solution if subjected to freezing temperatures

Why is FALK a good name in industry?

A business institution acquires a fine reputation, not because of its size, not because of the dividends it pays, not because of the patents it holds; but because of the acceptance of its products and methods of doing business by prospects, by customers, and by its employes.

For over fifty years prospective customers for Falk products have been gracious in their acceptance of Falk representatives.

Actual customers have purchased and repurchased Falk products year after year.

Falk employes are proud to be associated with the Falk Corporation, and verify their pride by many years of service.

This is evidenced by the Navy's acceptance of Falk products since before World War I; by the attitude of the Falk management toward Falk employes during the lean years of the economic cycle; by the honors bestowed upon Falk officials; by recognition of the high standards of its employe relations accorded by a national magazine; and by interplant and office activities of the employes themselves.

It has long been an axiom of the Falk management that "to build a better product, first improve the man." Falk quality is due in no small measure to the thoroughness of Falk apprenticeship courses.

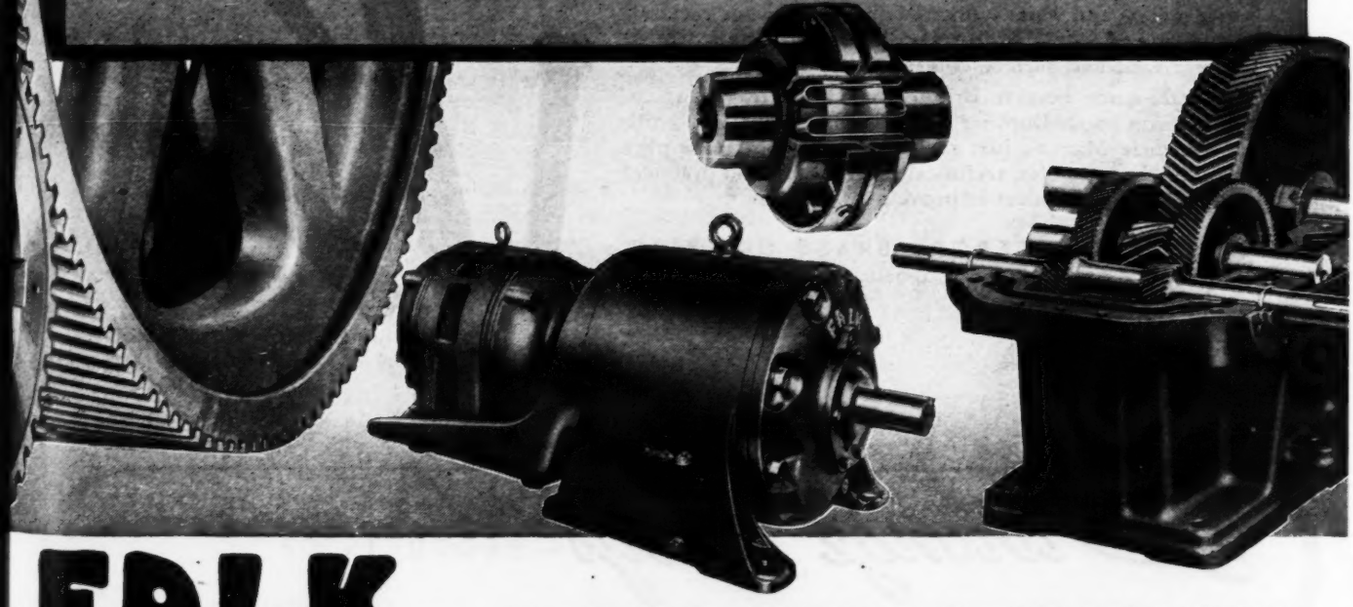
The same thoroughness employed in molding men is employed in molding Falk material. Falk casts its own steel in its own foundry to its own specifications.

To secure the watch-like precision so characteristic of all that Falk produces, it has always been the Falk policy to design its own machinery.

Because Falk has always known its men, its material, and its tools, it logically follows that Falk engineering has always been better than it could have been, had this engineering been done with unknown components.

All of this is just plain good business. No reputation can ever be acquired, much less maintained, unless it is based on plain good business. For plain good business is business that is good first for the customer, then for the employe, then for the corporation—and only then for the management.

This is why Falk is "a good name in industry".



FALK...A GOOD NAME IN INDUSTRY

THE FALK CORPORATION, MILWAUKEE 8 WISCONSIN

District Offices, Representatives, or Distributors in principal cities

PRODUCT IMPROVEMENT THROUGH DURONZE TO DEFY TIME AND CORROSION OVER 100,000 P.S.I.!

The unnecessary waste of manpower, equipment and interrupted service caused by failure of bolts, screws, and other fasteners made from improper materials deserve the serious attention of engineers and manufacturers. With today's progress in engineering alloys, it is not necessary to use materials that waste away from rust or fail without warning due to season or stress corrosion cracking.

For example, fasteners, fittings and connectors made from Duronze average approximately 100,000 pounds per square inch in tensile strength as compared to ordinary materials which when manufactured are approximately 70,000 pounds per square inch and deteriorate rapidly with time. Duronze defies time and maintains its strength and dependability despite moisture, continuous stress, temperature extremes, weathering, smoke and corrosive gases.

Engineers interested in preventing costly failures and reducing maintenance should specify high strength, corrosion resisting Duronze for bolts, nuts, wire and cable connectors; U bolts, cap, machine and wood screws; nails and other fastenings. Duronze is ideal for applications such as power and communication lines; railway signal apparatus; outdoor construction; railway cars, ships, planes; water meters and water works equipment; sewage reclaiming plants, process industries, industrial applications; underground and surface construction.

Contact your nearest Bridgeport Office for complete information about Duronze Engineering Alloys, and write for Duronze Manual, just revised, which contains eighty pages of charts, tables, technical information and practical suggestions for product improvement.

"Bridgeport" Brass Co.

BRIDGEPORT BRASS COMPANY
BRIDGEPORT 2, CONN. • *Established 1865*

NOTE: *Bridgeport does not make fastenings, but supplies wire and rod to screw and bolt manufacturers.*

Duronze Alloys—PRODUCTS OF

BRIDGEPORT BRASS

automatic and electromatic filters (in the illustration, made by the American Air Filter Co., Inc., Louisville, Ky.) with sprinklers and with an automatic tripping device; details are shown herewith.

•

Vertical Guide Bearings

I—Friction Loss

By H. W. HAMM,
Designer, S. Morgan Smith Co., York, Pa.

Guide bearings of vertical shafts such as on waterwheels and generators do not support any appreciable load but serve to maintain the proper tolerances and prevent the shaft from vibrating. Theoretically, for the perfectly balanced rotating unit, the load is zero, and for this case the guide bearing becomes unnecessary. However, a small amount of unbalance inevitably exists, and guide bearings take up the load produced thereby. The bearing pressure is too small to account for the existing friction and the generated heat.

For the purposes of heat balance calculation it therefore becomes necessary to seek a method of approach which differs from the conventional sleeve bearing theory for wedge-shaped oil films. The latter depends on the coefficient of friction which is a function of the bearing pressure and therefore in the case of the guide bearing of no significance. Instead of a wedge shaped oil film, a guide bearing has an oil film of equal thickness around the circumference of the shaft. The shear stress in an oil film of this shape is according to Newton's law for viscous flow, expressed as the formula (see Reference 1)*.

$$S = R\,\mu = \frac{U}{h}\,\mu = \frac{\pi D n}{30} \times \frac{\mu}{C} \qquad (1)$$

where

S = Shear stress in pounds per square inch
μ = Viscosity of oil in Reyns, pounds-seconds per square inch
R = Rate of shear in radians per second
U = Surface velocity of moving member in inches per second
h = Oil film thickness in inches
$C = 2h$ = Diametral clearance in inches
D = Bearing diameter in inches
n = Revolutions per minute

The resisting torque caused by fluid friction is equal to the stress times the lever arm times the area of the shaft surface, thus

$$M = \frac{D^2 L n \mu}{6 C} \qquad (2)$$

where

M = Torque in inch-pounds
L = Length of bearing in inches

The power loss of the bearing will be:

$$H_1 = \frac{D^2 L n^2 Z}{C \times 1.04 \times 10^6} \qquad (3)$$

where

H_1 = Power loss in B.t.u. per hour
Z = Viscosity of oil in Centipoises

Discussions on friction energy and heat dissipation will be presented in subsequent issues.

Reference used in this article:
1. Lubrication: A. E. Norton; McGraw-Hill Book Co., New York, 1942, page 16.

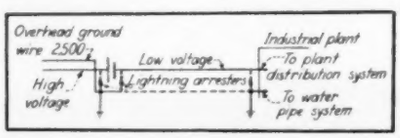
•

How to Protect Metering Equipment

IV—Industrial Meter Protection—Low Voltage

By R. F. QUINN*
Central Station Engineering Division, General Electric Co., Schenectady, N. Y.

Protecting metering equipment when an industrial plant is supplied through a transformer bank as shown and so located as to result in long-exposed secondary leads brings an additional problem to the primary



PLACING of lightning arresters to obtain maximum protection when the plant is supplied by a long exposed secondary from a transformer bank

protection previously discussed. Low voltage lightning arresters should be provided on the secondary side of the transformer and also at the point where the secondary lines enter the building. The grounds of the secondary arresters at the transformer should be tied in with the primary arrester ground. The ground leads of the arresters located at the service entrance should be connected to the water pipe system, conduit, metering equipment ground, motor frames, etc. in the building, and may be tied in with the primary arrester ground.

In considering the degree of exposure of secondary circuits, it must be remembered that any overhead secondary lines strung between buildings in an industrial plant are all a

* Equations, illustrations and references are numbered consecutively for the series of three articles. References are listed at the end of each article.

* Series began in the ELECTRICAL WORLD, January 20, page 133.

MATTHEWS SECONDARY CUTOUTS.

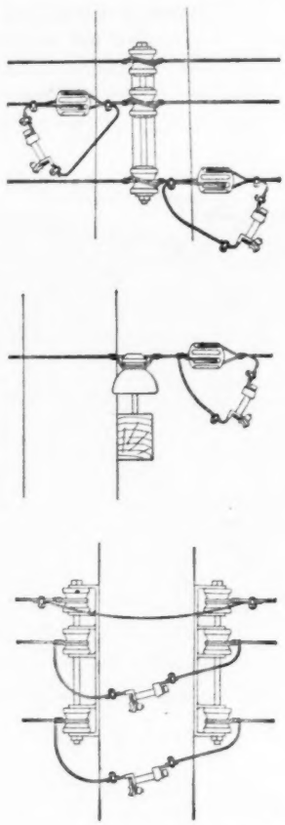
Rating:
100 Amperes 250 Volts
Rupturing Capacity
5000 Amperes

You can fuse them with any make of standard primary fuse links.

They indicate outages.

For isolating service entrance faults; for protecting banked transformer secondaries; or for protecting transformers from secondary faults, Matthews Secondary Cutouts have proved themselves very efficient and low-in-cost for many years.

For Sectionalizing as shown below.



Send for Bulletin 101-A.

W. N. MATTHEWS CORPORATION
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3 CONDENSING PLANTS

Since October, 1939, three new generating units, built and designed by Stone & Webster Engineering Corporation, for a Southeastern utility have been placed in operation. The surface condensing plants for all three turbine-generators were built by Ingersoll-Rand.

FIRST CONDENSER INSTALLED AND TESTED

In recommending Ingersoll-Rand for the first new unit, the contracting engineers spoke with the confidence based upon the many hundreds of outstanding I-R condenser installations, not a few of which Stone & Webster had installed. Tests made on the first condenser, a single-pass divided type serving a 40,000-kw generator unit, showed that performance guarantees for all operating conditions were exceeded by a wide margin. Moreover, the station operating manager called attention to the fact that the I-R hotwell construction provided condensate almost entirely free of oxygen and reheated it to inlet temperatures.

Ingersoll-Rand equipment serving this condenser included a two-stage steam-jet air ejector, vertical propeller-type condensing water circulating pump and two hotwell condensate pumps.

SECOND CONDENSER INSTALLED AND TESTED

Several months after the initial installation was placed in operation, an additional 40,000-kw generating unit was ordered for another station. The tests of the initial plant had already been made and thoroughly studied, and the efficiencies that they demonstrated influenced the selection of Ingersoll-Rand equipment.

As before, steam-jet removal equipment, as well as condensate and circulating water pumps were supplied by Ingersoll-Rand.

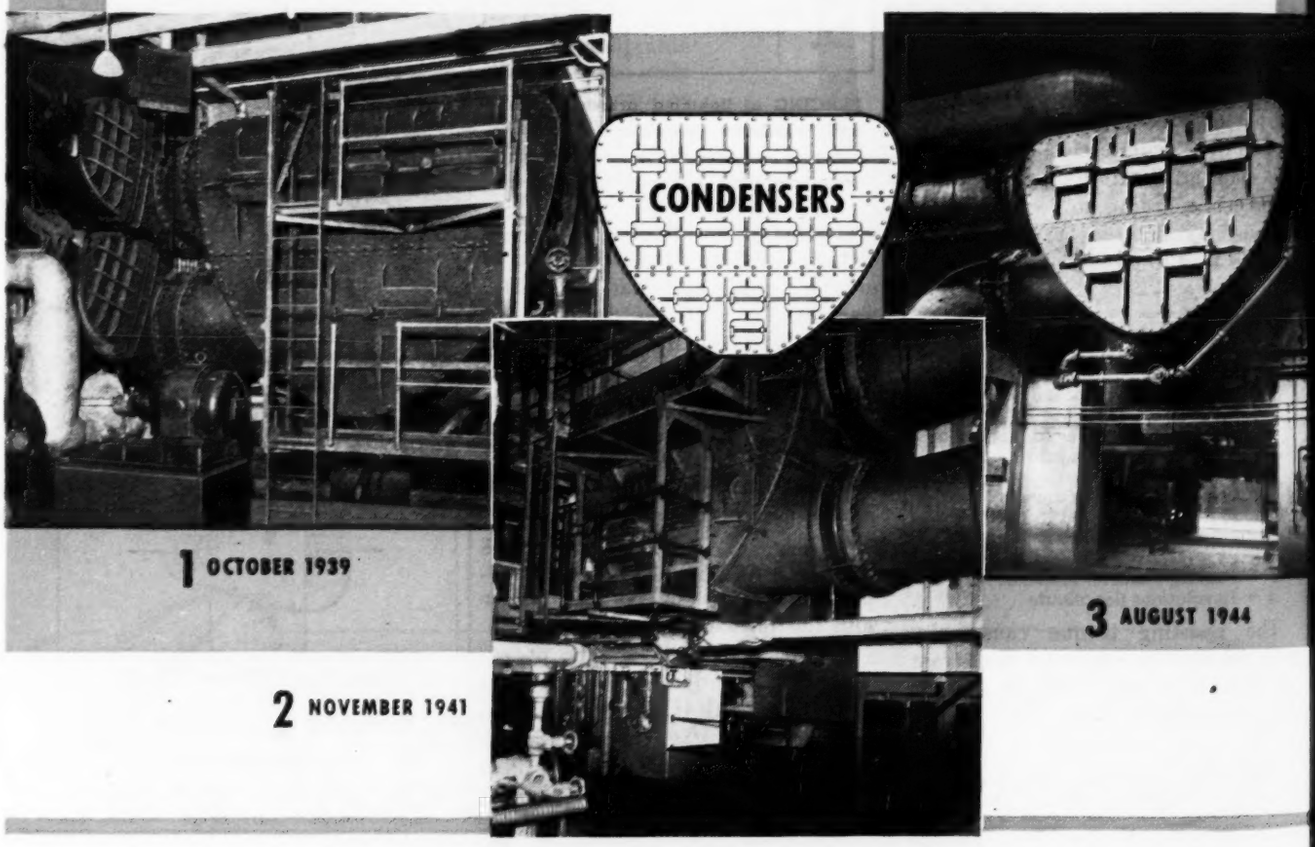
THIRD CONDENSER NOW OPERATING

In 1944, Stone & Webster completed a new plant for this same Company. One 50,000-kw turbine-generator was installed in this station, and it is served by an Ingersoll-Rand condensing plant.

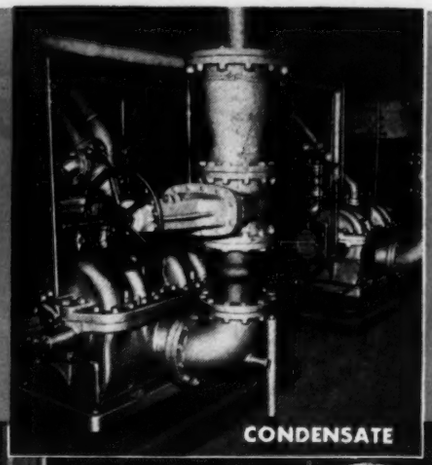
This third order illustrates the confidence which both the Utility Company and Stone & Webster Engineering Corporation have in Ingersoll-Rand condensing equipment.

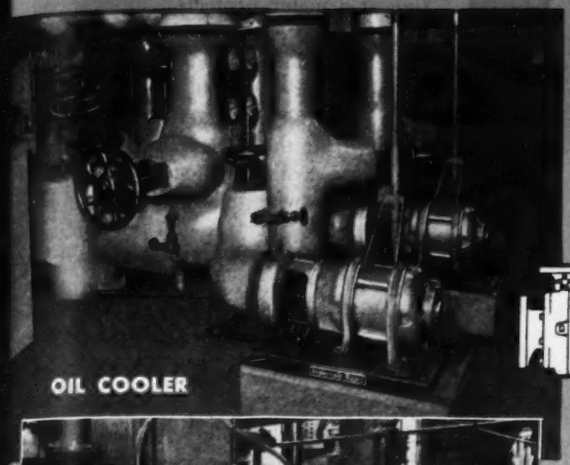
• • • •

Ingersoll-Rand's many years of original and progressive condenser design, the construction refinements that reduce maintenance to a minimum, and the results obtained in actual installations are sound recommendations for the selection of Ingersoll-Rand Condensing Plants.

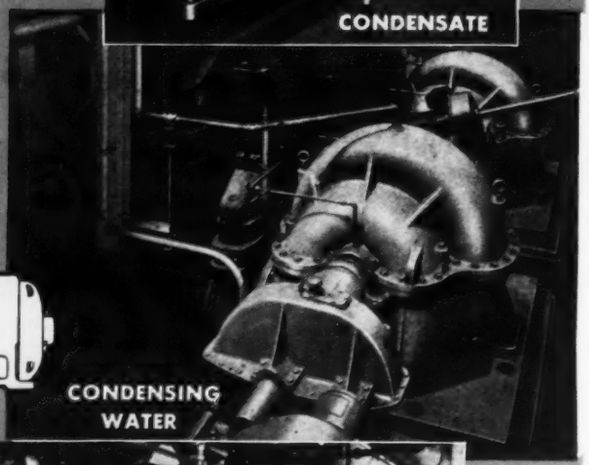


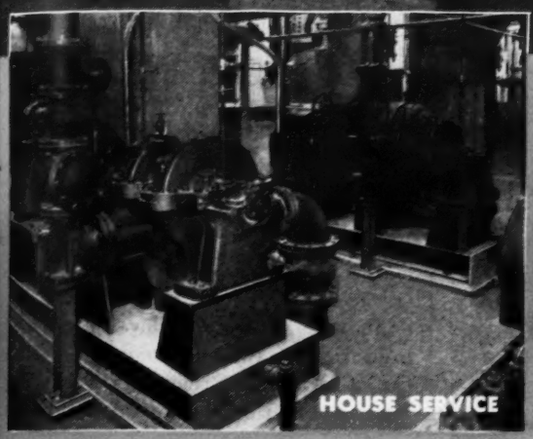
FOR 130,000 KW
Expansion Program of a Southeastern Utility

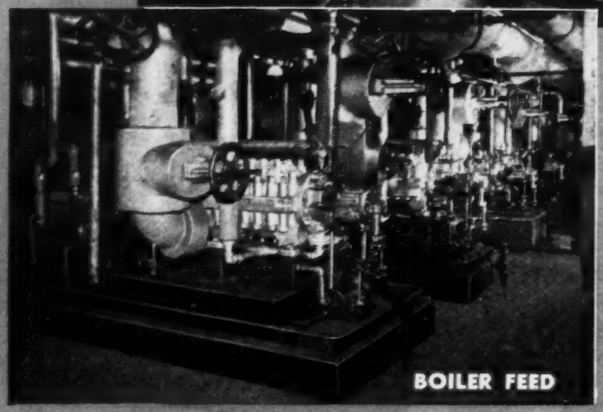

CONDENSATE

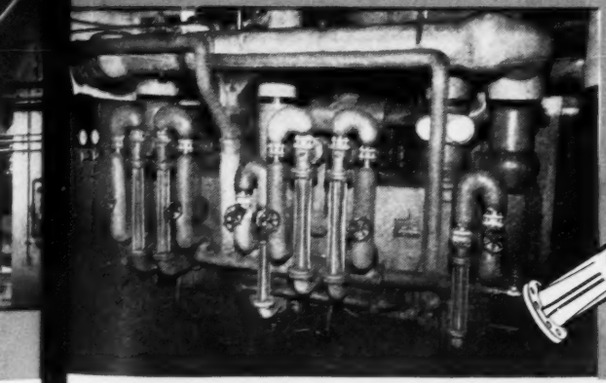

OIL COOLER

PUMPS

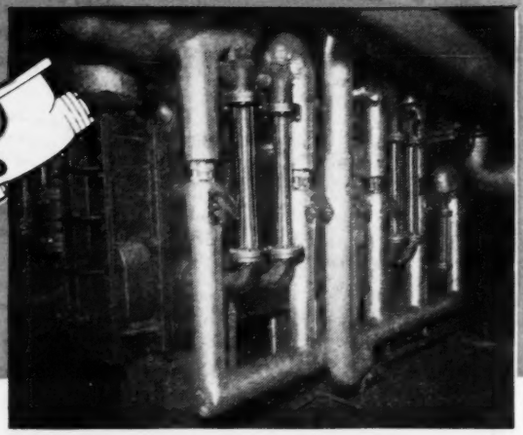

CONDENSING WATER


HOUSE SERVICE


BOILER FEED



AIR EJECTORS



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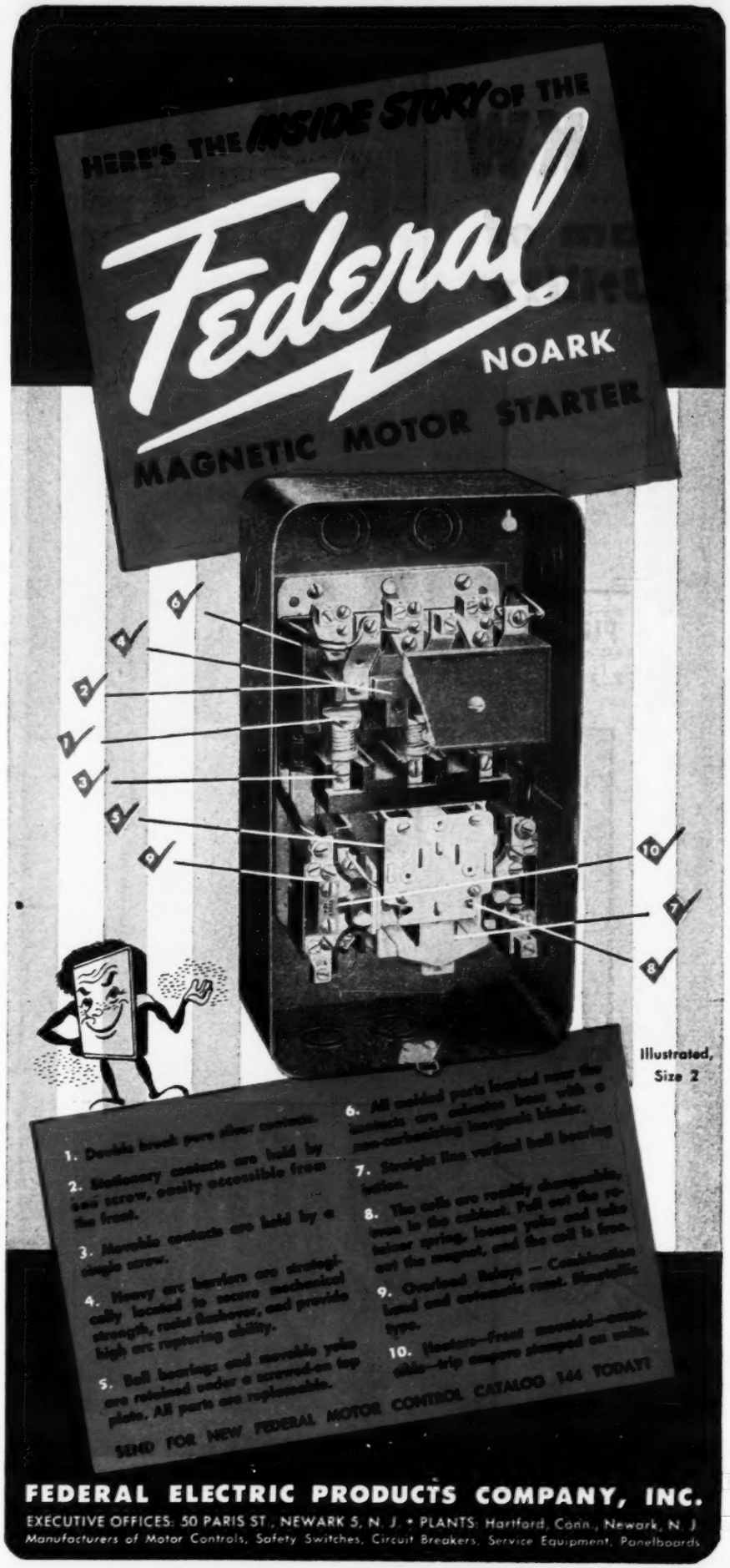
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7. Straight line vertical ball bearing action.
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part of the exposed system and hence subject to either direct or induced lightning voltages which may be imposed on meters and other service entrance equipment.

Over-Voltage Protection

Lightning damage to polyphase watthour meters can be practically eliminated by the application of proper over-voltage protection. The lightning arresters shown at the industrial plant end of the low voltage circuit in the diagram are representative of a meter protector application. If such arresters are not applied, then a meter protector should be applied at the meter location. The modern watthour meter has an impulse strength in the order of 8 kv. and there are available meter or service protectors which hold the voltage down to less than one-half the impulse strength of the meter and thus provide an adequate margin of protection. The polyphase protector has three line leads and a ground lead. One line lead should be connected to each phase conductor close to the line side terminals of the meter inside the meter box; the ground lead should be connected to any grounded secondary conductor or neutral and to the grounded conduit system.

•

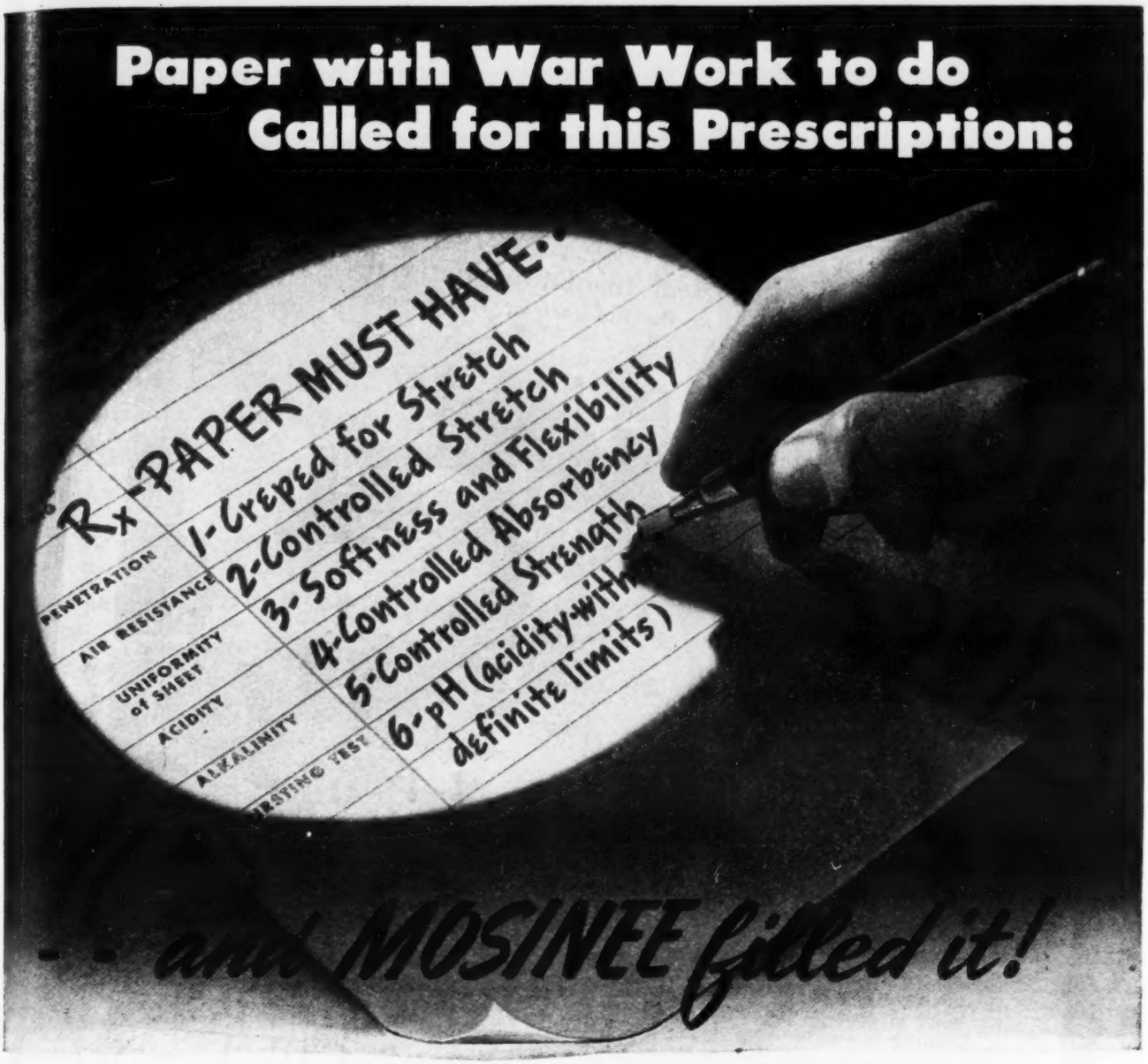
Tools Clean Rot from Standing Poles

Shown are two tools developed and used by the Commonwealth Edison Co., Chicago for removing decayed heart wood from the top of standing

CHISEL AND SCOOP used for removing decayed heart wood from tops of standing western red cedar poles preparatory to repair

western red cedar poles preparatory to sterilizing and filling the cavity with a pentachlorphenol fly ash paste. The tools consist of a chisel and a scoop; both about 18 in. long. The repair technique in which these tools are used was described in ELECTRICAL WORLD, December 23, 1944, page 77.

Paper with War Work to do Called for this Prescription:



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A SAMPLE PAGE

Temperature Tests

C-D Electrical Insulating Materials

VIII. Tests on the Influence of Temperature

By A. E. PARKINSON.

Temperature affects the moisture-carrying capacity of air and that airborne moisture in turn affects the electrical properties of insulating materials; but temperature also has a more direct influence. Two examples of its effect on the dielectric strength of Dilecto are presented graphically herewith. The curve marked "Sheets" in Fig. 1 is a composite curve for grades X, XP, XX and CE Dilecto of ⅛ inch thickness, while that designated "Tubes" in Fig. 1 is a composite curve for grades X and XX rolled tubing of 1/16 inch wall thickness. In both cases the dielectric strength falls steadily as the temperature increases. Parentheticallly it may be remarked that the slope of the curve would change according to the thickness of the sheet or the wall thickness of the tube being tested.

It is obvious from these examples that temperature does have an important influence on dielectric strength, and it may be a determining factor in circumstances where the insulating material becomes hot, either from external causes or from the influence of the current against which it acts as a shield.

Figure 2 shows the influence of temperature on the insulation resistance of several types of insulating materials. It will be noted that in most cases the insulation resistance remains practically constant up to a certain temperature, dependent on the material, then falls rapidly to about one-fifth of its original value (at 27° C.), after which the decrease slows up. Even Dilectene, which is the best of the examples given, begins to show a loss at about 75°C.

When interpreting these curves for a given application, one should also consider the initial Insulation Resistance and the effects of changing moisture conditions as discussed in other articles of this series.

The author making insulation resistance tests.

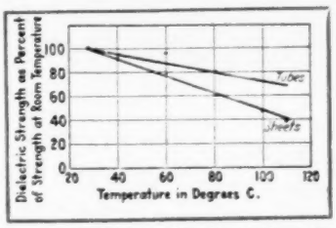

FIG. 1—Variation with temperature in dielectric strength of Dilecto

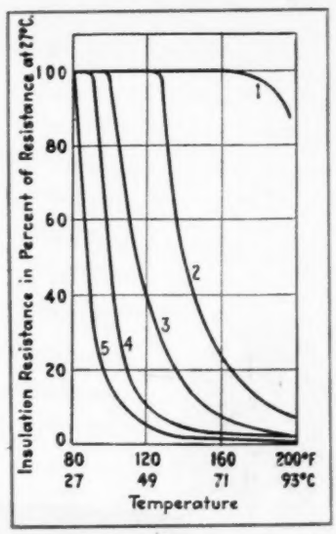

FIG. 2—Variation with temperature in insulation resistance of (1) Dilectene, (2) Dilecto Grades XXX or XXXP, (3) Dilecto Grade C, (4) Vulcanized Fibre & Vulcoid, (5) Celoron.

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- ★ Dielectric Strength Tests
- ★ Arc Resistance Tests
- ★ Tests on the Influence of Water
- ★ Tests on the Influence of Temperature
- ★ Tests on the Influence of Frequency

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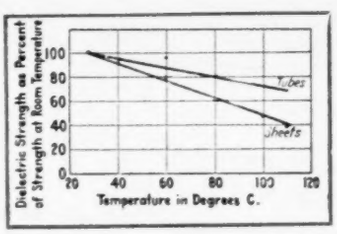

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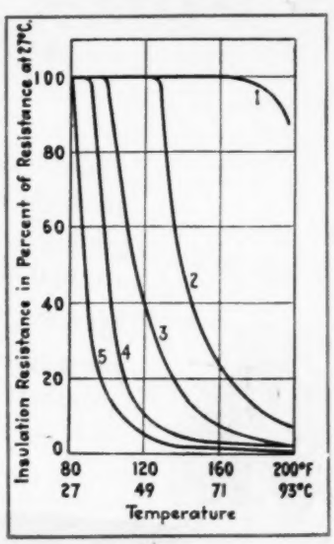

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Electrostatic Detearing Speeds Paint Drying

Electrostatic detearing apparatus for ridding coated articles of the final surplus paint which tends to congeal at lower edges, has been installed at Commonwealth Edison Co. testing laboratories in Chicago, for use in conjunction with infra-red drying tunnels. This equipment is at the service of customers who are studying drying and finishing problems.

This method of eliminating "tears" makes a wider use of dip finishing possible, effecting the economies of straight-line production and saving paint otherwise wasted by the spray method. Paint droplets spoil the appearance of finished products and tend to cause them to remain "tacky" after other portions are dry. Tears have a tendency either to smear or produce incomplete coverage if they are accidentally wiped or knocked off. Moreover, a longer drying time is required to harden the surplus paint than the finish on the remainder of the article.

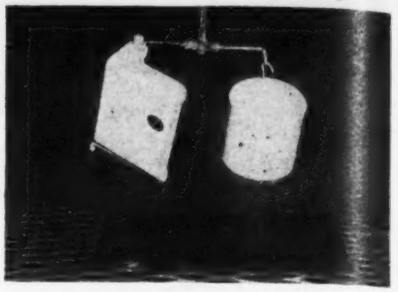
The apparatus at the Edison laboratory consists essentially of a transformer that steps up the ordinary supply potential to 85,000 volts a.c. This high voltage current is then converted to unidirectional pulsating current by means of a high voltage vacuum tube rectifier.

High voltage is led off to a "grille" or square of metal lath insulated from ground. The dipped article passes along above the grille, suspended from a trolley. It is at ground or neutral potential; that is it is composed of an equal number of positively and negatively charged particles which neutralize each other.

According to the law of electrically charged bodies, the positive ions in the work piece are attracted by the great number of negative charges on the grille. The work piece itself cannot move itself toward the grille, but the fluid paint can and does. It "flies" off the piece and is deposited on the grille; see above illustration.

ELECTROSTATIC DETEARING APPARATUS installed in conjunction with infra-red drying tunnel speeds paint drying by removing surplus paint

Due to the intensity of the field at or near the work piece the air in this region is ionized. This augments or accelerates the transfer of paint particles from the work piece to the grille.



FINE STREAMERS of surplus paint, above, are pulled from the edge of work pieces by electrostatic force

In addition to metals this detearing process lends itself equally well to such materials as wood, rubber plastics and earthenware.

•

Dealers Want Help
Opinion Survey Shows

What electrical dealers want in the way of assistance from cooperating utility companies in peace time is revealed in the accompanying tabulation selected from the findings of an opinion survey recently conducted by the Wisconsin Power & Light Co., Madison.

The survey, conducted on a personal interview basis was confined to a representative group of 163 dealers out of the total of 605 operating in the territory served by the company.

From the tabulation it appears evident that dealers want company promotional and campaign literature (in advance), as well as assistance with market analysis and sales training. On the other hand they do not appear

What Wisconsin Dealers Want of Their Power Company

	Yes	%	No	Total
Want dealer publication each month	155	97	5	160
Advance information on company campaign plans	155	95	8	163
Feel that general meeting would be helpful	135	84	26	161
Want help on market analysis	124	80	30	154
Would cooperate on advertising	119	76	37	156
Interest in training school for supervisors and store display	117	72	45	162
Help in training salesmen	102	63	60	162
Interest in training school on business economics	102	63	59	161
Want help in product selection	60	37	102	162
Want help in developing salesman compensation plan	53	33	107	160

To the THOUSANDS of Westinghouse
Appliance Dealers and Service People
who will attend the 1945
CONSERVICE TRAINING SCHOOLS

Wrapped up in a *fast moving* program will be everything needed to help you meet today's

STEPPED-UP SERVICE DEMANDS

Never was the service situation so critical as it is today. Practically all electric appliances are at least three years old. So, for the sake of home front morale, everything possible must be done to keep them on the job.

That's the whole purpose of the 1945 Conservice Training Schools. And the aim this year is to crowd the broadest and most thorough education into the fewest number of hours.

Accordingly, there are no frills to this program. From the sound of the morning bell it's all brass-tack demonstration and discussion.

This will be a two-day school with sessions running either consecutively or at separate times.

First Session Will Be Devoted to All Refrigeration Products

Domestic and commercial models, fixture applications, water coolers, Mobilaires and milk coolers will be thoroughly explained in this busy all-day session. A giant working model of a refrigeration control will be featured.

New Operational Demonstration Boards Facilitate Diagnosis and Correction of Trouble

Interesting demonstration props are employed to explain operating fundamentals and facilitate diagnosis of difficulties. Thus, in true clinic fashion, service people see all problems set up and participate in their solution.

Dramatic 30-Minute Full Color Movie Shows How Good Service Builds Good Will

This informative film takes a serviceman through all the important steps that go to make a satisfied customer and a profitable service call. Packed into 30 minutes is more down-to-earth training than a newcomer could get in months of trial and error experience.

Second Session Will Cover Electric Ranges, Water Heaters and Laundry Equipment

Model by model, the various appliances in this group will be put through their paces. The laundry equipment discussion will be divided into two parts with ample time devoted to the care and maintenance of both the Laundromat and conventional washers.

WESTINGHOUSE ELECTRIC & MANUFACTURING CO.

Appliance Division • *Plants in 25 Cities...Offices Everywhere* • **Mansfield, O.**

30 MILLION PRE-WAR

Westinghouse

ELECTRIC HOME APPLIANCES

YOUR PROMISE OF STILL FINER ONES TO COME

Check with Your Westinghouse Distributor for Dates of Meetings in Your Territory

The Westinghouse field service organization is all set to take to the road. Get the complete itinerary from your Westinghouse Appliance Distributor and make reservations for yourself as well as for your old and new service people.

Tune in: John Charles Thomas, Sunday, 2:30 EWT., NBC. • Hear Ted Malone, Monday, Tuesday, Wednesday Evenings, Blue Network

RUBBER POWER CABLES • VARNISHED CAMBRIC CABLES

CRESCORD

RUBBER JACKETED PORTABLE CORD

FOR LONG SERVICE ON TOUGH JOBS

Improvements in Buna-S (Government Synthetic Rubber) and the development of better manufacturing methods have resulted in an excellent portable cord, comparing favorably with CRESCORD formerly made with crude rubber which over many years had earned such an outstanding reputation for long life.

CRESCENT

WIRE and CABLE

CRESCENT INSULATED WIRE & CABLE CO.

TRENTON, N. J.

• IMPERIAL NEOPRENE JACKETED PORTABLE CABLES •

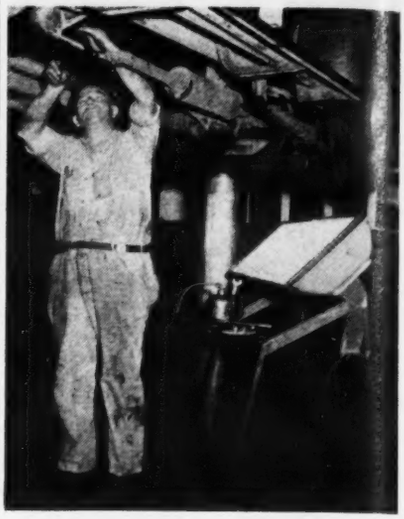
• ARMORED CABLE • CRESFLEX NON-METALLIC SHEATHED CABLE • SERVICE ENTRANCE CABLE • BUILDING WIRE

PERMACORD • LEAD-ENCASED AND PARKWAY CABLES • SYNTHOL WIRES • WELDING CABLES • SHIPBOARD CABLES

to welcome assistance with product selection or salesman's compensation plans.

•

Truck Maintenance Light



FLUORESCENT FIXTURE shown in use, above, at the garage of the Indiana Service Corp., Fort Wayne, has eliminated the complaint of automotive maintenance men that they couldn't see to work on the under side of cars, trucks and motor buses with only an old-fashioned drop-cord trouble lamp

This new fixture designed by company lighting engineers to solve the problem is a three-lamp, open-type industrial fluorescent luminaire, covered with non-breakable glass (sand blasted on the back), mounted on an angle iron frame provided with casters. The fixture can be tilted to any angle. Note the tool shelf.

•

Home Makers' Quiz Aids Electric Usage

By EMMA MAURICE TIGHE
Home Service Director, Boston Edison Co.

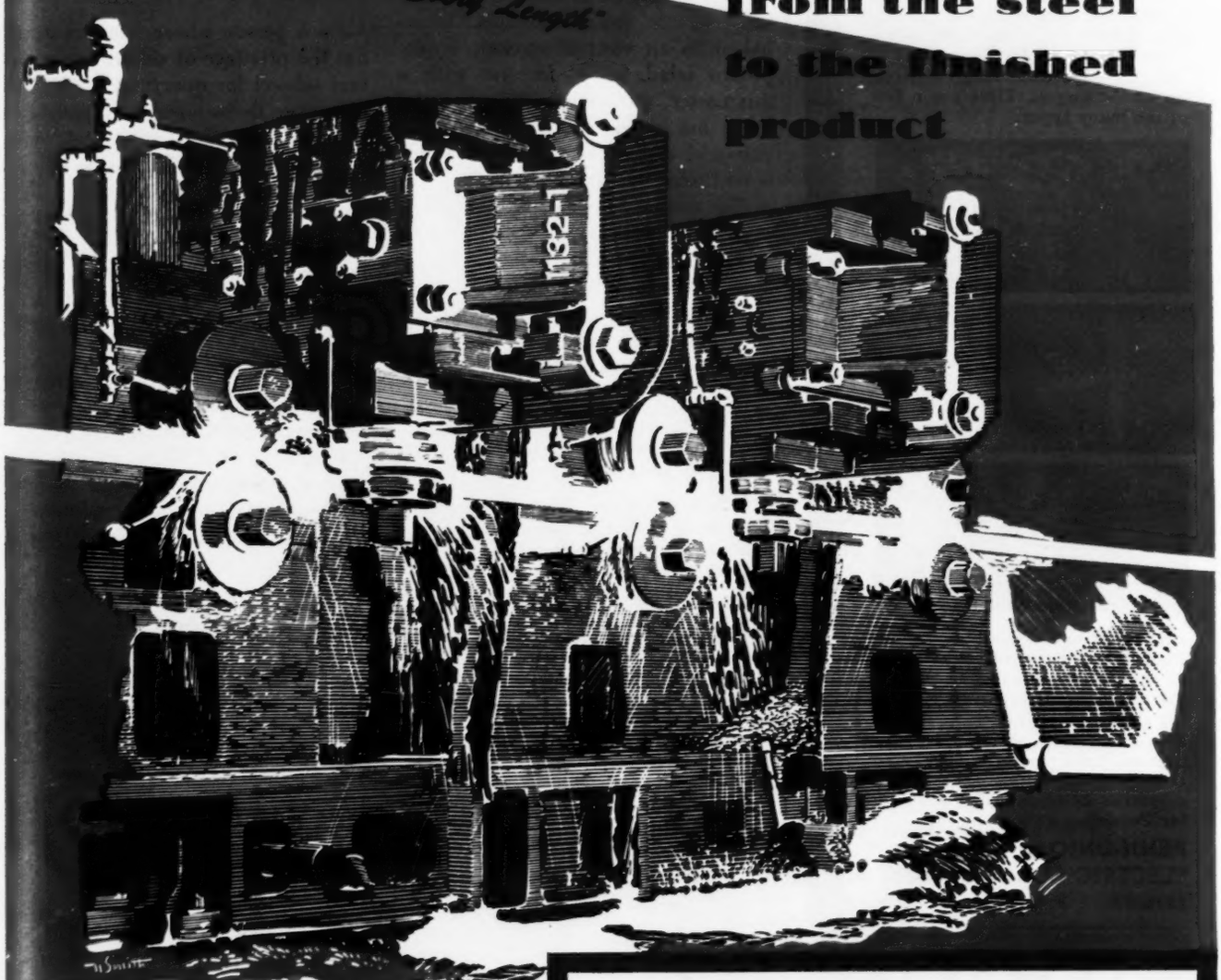
To increase popular interest in electric home service and help consumers to utilize appliances most effectively under war conditions, the Boston Edison Co. recently added a quiz program to the presentations of its promotion department before neighborhood and other groups of women. The objective is to combine entertainment and the stimulation of an informal contest with practical demonstrations of appliance service, accenting the usefulness of electrical household devices in obligato fashion during the proceedings. The idea has been most favorably received by audiences attending these gatherings.

As members of an audience arrive at the meeting place, each registers on a card which is dropped into a receptacle. The program then goes for-

The quality of

CENTRAL RIGID STEEL CONDUIT

. . is controlled from the steel to the finished product



Ingeniously designed welding rolls where the white hot skelp is accurately shaped and securely welded into pipe immediately after it emerges from the furnace. It is from this quality controlled pipe that Central Conduit is made.

SPANG-CHALFANT

Division of The National Supply Company

General Sales Office: Grant Building, Pittsburgh 30, Pa.

District Offices and Sales Representatives in Principal Cities

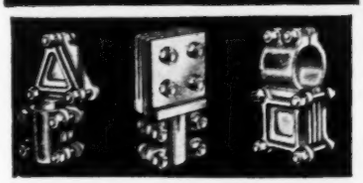
"When you need ANY Power Connector—

—see the COMPLETE line"

Probably the exact Power Connector you want is shown in the Penn-Union Catalog.

You will find Tee, Stud and End Connectors, Bus Supports, Terminals, Elbow and Cross Connectors, Couplers and Reducers—

—each in a wide range of sizes, up to the largest. Here are a few of the many types:



Also the most complete line of Cable Taps, Straight and Parallel Connectors, Lugs, Grounding Clamps — every good type.

Leading utilities, industrials, electrical manufacturers and contractors have found that *"Penn-Union" on a fitting is their best guarantee of Dependability.* Write for Catalog.

PENN-UNION ELECTRIC CORPORATION
ERIE, PA. *Sold by Leading Jobbers*

PENN-UNION
Conductor Fittings

ward and may consist of an electric cooking demonstration or the presentation of a film like "The Way to a Man's Heart," or some other screening appropriate to home electric service, usually obtained through the cooperation of an electrical manufacturer. The quiz is then inaugurated, usually by the home service department representatives in cap and gown to furnish an academic setting. Fifteen subjects are listed on large display cards placed in the demonstration table, and four questions have been prepared under each topic. A name is drawn at random from the receptacle, and if the queries are correctly answered as to specific detail or in the spirit of the inquiry, a prize is awarded to the person participating. This may be a cook book featuring electric usage, cookies, beans baked in an electric roaster, a pie, potato salad, bowls for use with a mixmaster, war stamps or some other item; but in all cases the underlying theme of electric service in the home is tied into the gift.

The questions cover a wide range, and some are in lighter vein comparable to those which would be acceptable in small parties. A few of these illustrate the procedure (omitting the headings of the topics):

Q. During a January blizzard, what item within the household, and what item not in the household, could you DEFROST?

A. Refrigerator. Wind shield.

Q. What six-letter word is a home maker MUST in properly caring for home and family?

A. System. Sifter, Washer, Vacuum.

Q. Name the well known chorus which is a lament of food left uncovered in an electric refrigerator.

A. How dry I am.

Q. What first step in sewing is not necessary in electric cooking?

A. Basting.

Q. What 11-letter word is prominent in making washday playday?

A. Electricity.

Q. Name the Boston Edison poster whose message lessens home accidents at night.

A. The Light Within.

Q. What name is suggested when a match flame is applied to the tip of needle?

A. Hotpoint.

Q. Devoid of warmth, the speaker's nouns were compounded with air and ice cubes. Who was his sponsor?

A. Frigidaire.

Q. A Sunday radio program at 2:30 features one individual with three first (or common) names. Name the celebrity and the sponsor.

A. John Charles Thomas—Westinghouse.

Q. A circlet inclosing two letters of the alphabet or the insignia of four gold stars. Who is the sponsor?

A. G. E.

Each person whose name is drawn has the privilege of selecting the general subject for querying. A committee from the audience is named to help determine the accuracy of replies in doubtful cases; but as a rule the home service representative suffices to act in this capacity and makes the prize awards. Between each grouping the quizmaster asks her assistant. "Has Boston Edison anything to say?" The assistant jumps to attention, rings the bell and makes one of the company's spot radio announcements. These refer to all phases of electrical home making, cooperative war effort, etc. These quizzes have proved highly enjoyable to the public, and have served to maintain interest in electrical appliance utilization.

TYPICAL QUIZ PROGRAM keyed to making efficient use of electricity in the home. Left to right, Virginia Comstock, Emma Maurice Tighe, Gertrude McCourt

BH EXTRA FLEXIBLE FIBERGLAS SLEEVING

MAKE THIS
FLAME TEST
Hold a match under a piece of BH Extra Flexible Fiberglas Sleeving. The flame does not burn, char or otherwise affect it. And temperatures much higher than usually encountered electrically are just as readily resisted by the inorganic Fiberglas!
BH EXTRA FLEXIBLE FIBERGLAS SLEEVING
2 WAYS BETTER
NON-FRAYING • NON-STIFFENING

FEW electrical insulations can double in brass as heat insulations. Yet so effectively heat resistant is BH *Extra Flexible* Fiberglas Sleeving that actual service records show it refuses to burn even in direct contact with heat units. The reason—both yarns *and* impregnation are non-inflammable!

A special gum base and dye applied by an exclusive BH process is responsible for many more features. It permanently *prevents fraying, stiffening and abrasive wear*. The sleeving is unusually flexible and takes the roughest handling without fraying. It does not harden and crack with age—lasts indefinitely without deterioration. It is also non-crystallizing at low temperatures.

Fiberglas is non-absorbent and unaffected by moisture, oil or grease—qualities ideally suited to appliance manufacture for instance. And it has high dielectric and tensile strength.

"Punishment" tests prove that BH *Extra Flexible* Fiberglas Sleeving is the most logical insulation for a host of tough jobs. Why not see for yourself? It's available in all standard colors and all sizes from No. 20 to 5/8", inclusive. Write for samples today and compare!

BH SPECIAL TREATED FIBERGLAS SLEEVING UNAFFECTED BY HEAT UP TO 1200°F!

This is a high quality sleeving that will not fray when cut and withstands heat up to 1200°F. Yet no saturant is used in the exclusive BH process! Flexible as string, too. Made in natural color only—all standard sizes. Try it!

BH PRODUCTS

ALSO SLOW-BURNING IMPREGNATED MAGNETO TUBING • SLOW-BURNING FLEXIBLE VARNISHED TUBING • SATURATED AND NON-SATURATED SLEEVING

BENTLEY, HARRIS MANUFACTURING CO.

Dept. W Conshohocken, Penna.

NEW EQUIPMENT

Fluorescent Lamps

Type LS fluorescent lamps: single contact base; 3500 deg. white. **Sylvania Electric Products, Inc.**, Salem, Mass.

Fluorescent lamp designed to operate without starters, and it is reported, may be operated in series on a single ballast at 100 or 200 milliamperes. Specification sheet lists four sizes (42, 64, 72 and 96 in.) with output up to 3300 lumens. Efficiencies of 65 lumens per watt are reported.

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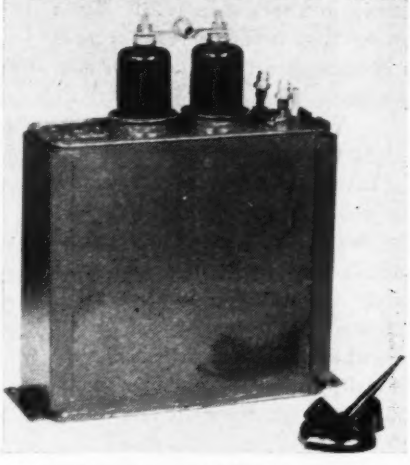
Capacitor



High frequency parallel-plate capacitor: water cooled; ratings from 2,000 v., 0.025 mf. to 9,000 v., 0.0056 mf. **General Electric Co.**, Schenectady 5, N. Y.

Units are designed for use in resonant circuit, or "tank circuit" of high frequency electronic oscillators. Cases are reported constructed of non-magnetic metal with hermetically sealed joints and are filled with a liquid dielectric under vacuum.

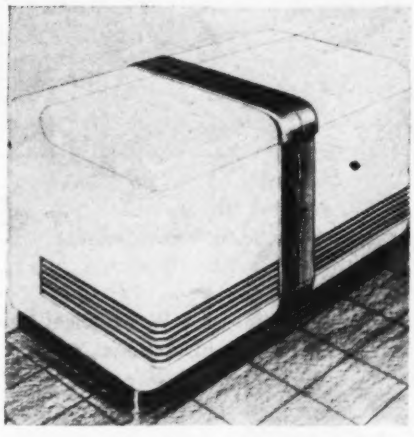
•

Disconnect Switch

Crane safety disconnect switch: operate 450-hp. connected motor load. **Electric Controller and Mfg. Co.**, Cleveland 4, Ohio

Switch designed to comply with safety regulations of those states requiring separate disconnecting device on overhead cranes. It has an externally operated handle which is arranged for padlocking in off position. Three optional arrangements of terminals are available to facilitate incoming and outgoing connections. Switch is of d.c. type, double pole design, and enclosed in either a general purpose or semi-dust-tight enclosure.

Home Freezer



Farm and Home Freezer: table top; 2 cu. ft. freezing compartment; 6 cu. ft. storage; size 24 by 36 by 44 in. **Ben-Hur Mfg. Co.**, 634 Cast Keefe Ave., Milwaukee 12, Wis.

Table-top style freezer with inset base to harmonize with other electric kitchen appliances. Cabinet is of steel construction and has separate freezing compartment. Unit is reported as having 200 lb. food storage space.

•

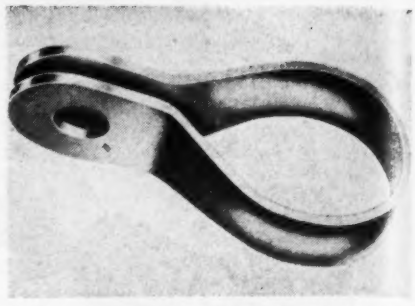
Relay

Type "50X8X" "memory" 2 coil relay: 6 to 200 amp.; a.c. or d.c. types. **Struthers-Dunn, Inc.**, 1321 Arch St., Philadelphia 7, Pa.

Relay is said to make possible make-before break, or break-before-make contact combination. It operates from momentary impulse. Application of power to one coil latches contacts into one position; power then applied to other coil throws contacts into a second latched-in position. A third unlatched position is reported obtained by energizing both coils simultaneously.

BUYING ELECTRICAL EQUIPMENT?—McGraw-Hill's *Electrical Buyers Reference* is a convenient place to look first for manufacturers' product data, names and addresses.

Clevis Ring



Clevis ring: cadmium plated. **Poulsen & Nardon, Inc.**, Box 2398, Los Angeles 54, Calif.

Clevis ring made of alloy steel by a stamping operation which is said to retain full strength qualities of the steel. Report states that the strength of the ring exceeds that of the cable with which it is used. Ring is said to conform with specification ANQQ-P-421 and is made in sizes to fit any standard cable.

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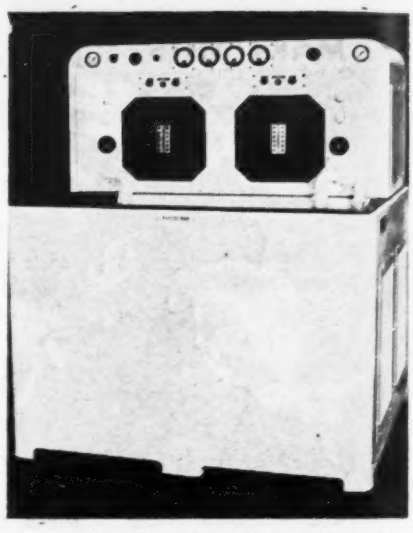
High Frequency Equipment



Two station electronic heating machine: 450,000 c.; 20 kw. output; 220/440 v.; tubes, air and water cooled; work inductors, water cooled; size, 57 by 51 by 68 in. **Ohio Crankshaft Co.**, 3800 Harvard Ave., Cleveland 1, Ohio.

Tube-type unit, with two independent work stations which can be operated at the same or different frequencies, housed in a welded sheet metal cabinet. Controls and meters are located in the "penthouse" frame. Manual controls used for set up can be switched to automatic when the heating cycle is determined.

•

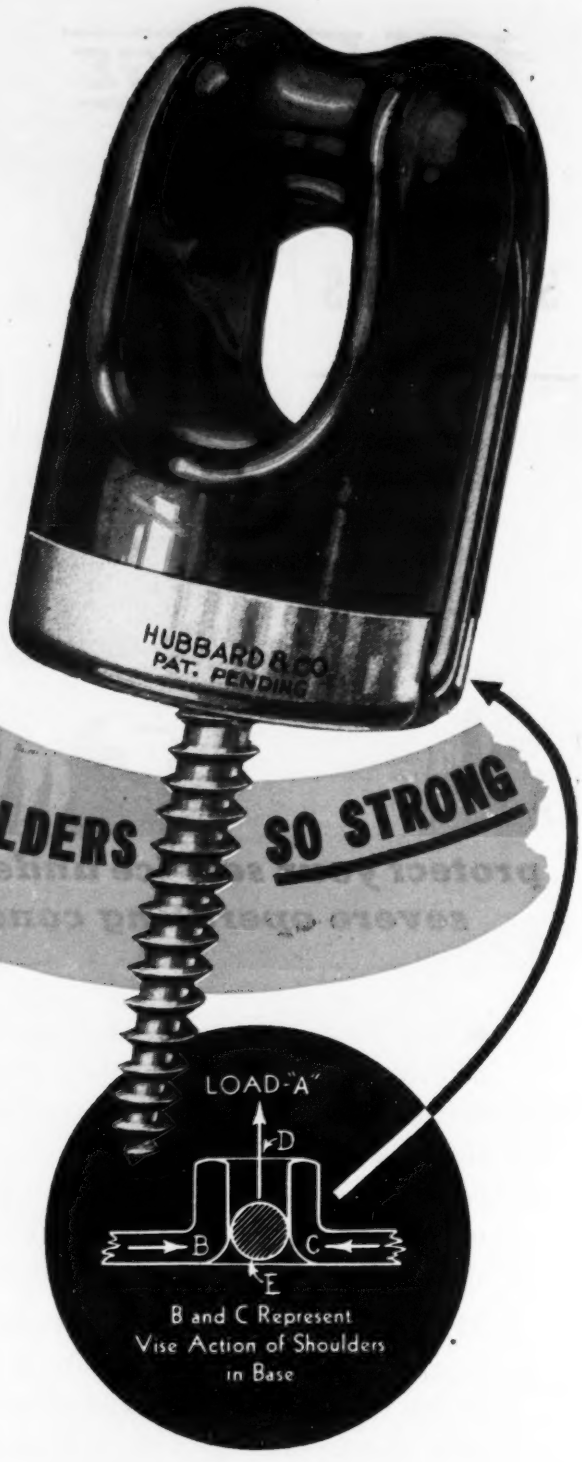
Cable Terminator

Dual-purpose "J" terminator: sizes for conduit from 1 in. to 4 in. **O. Z. Electrical Mfg. Co.**, Brooklyn, N. Y.

Terminator can be used as a sealing fitting or as a pulling or splicing chamber and can be installed outside of chambers without disturbing the electrical installation. When installed with cabinets, the conduit is terminated below the box, the device is installed at the end of the conduit and tied into the box with a chase nipple.

WHY?

ARE HUBBARD NO. 4-11-44 WIREHOLDERS SO STRONG



When a dead-end load is applied to a Hubbard 4-11-44 Wireholder, the first thing that happens is a close conformation to the porcelain of the Copperweld wire bail, which runs around the wire hole. This distributes a compression load over the largest possible area of the porcelain. *The metal bail carries the load,* the porcelain merely rides the bail like a saddle.

This is evident on observing the construction of the Hubbard 4-11-44. But not so well understood, is how the bail-fastening to the base stands up so well. At first glance it would seem that increased loading would simply straighten out the hooked ends of the bail and cause them to let go. By referring to the diagram it will be seen why this is not so.

As the load is increased at "A" beyond normal strain, the base starts to "bow" up slightly at "D". Immediately the shoulders at "B" and "C" are drawn in against the bail "E", gripping it over a fairly large area, like the jaws of a vise. The harder the pull, the tighter the grip until the ultimate of the bail wire is reached.

*Tests have shown that before the bail breaks the normal mounting would long since have pulled loose. Attached to a solid beam of hard wood one Hubbard 4-11-44 Wireholder will support the weight of a light automobile.

**The full strength of any wireholder will not be developed by a poor mounting. Thin siding, soft splintery wood or loose bricks will give way under a very low strain. Avoid weak mounting.*

HUBBARD

HUBBARD AND COMPANY

PITTSBURGH . . . OAKLAND, CALIFORNIA . . . CHICAGO

HI-VOLTAGE

C-W Air Break SWITCHES

protect your service under the most severe operating conditions

● Top illustration shows the hinge end of a C-W Switch made during an ice test. The switch was warm, approximately 70°, when the spray was started and the ice deposit represents a six hour accumulation. A gradually applied pull of 60 lbs. on a 28 inch lever cracked the ice at the hubs of the cranks and freed the mechanism.

The lower picture shows the switch closed into contact through a heavy deposit of clear ice. The switch was closed at the speed of motor operation. This contact housing is not only a sleet hood but is also designed for ice breaking.

For dependable protection specify Hi-Voltage Air Break Switches.

HI-VOLTAGE
EQUIPMENT COMPANY
2891 East 79th Street • Cleveland 4, Ohio

TECHNICAL LITERATURE

X-Ray Applications—A 12-page booklet describing the X-ray diffraction technique and applications has been issued by the North American Phillips Co., 100 East 42nd St., New York, 17, N. Y. Diagrams, typical diffraction films, and several tabulations are given to show how this type of equipment is used for identification, research and production. Also included is a brief description of how X-ray diffraction films are interpreted.

Resistance Welding — How welding processes differ, how electronic control for resistance welding works, and how this method of control extensively adapts this welding process to industry, are set forth in a series of seven pocket size books. These lesson books, slide sound films (35 mm.), a quiz book and an instructor's manual comprise material for a training course in the theory and application of resistance welding control. For a 20-member class the material costs approximately $50 and is available from C. R. Riker, Supervisor, Extension Training, Westinghouse Electric and Manufacturing Co., 306 Fourth Ave., Pittsburgh 30, Pa.

Chemicals—Pocket-size booklet, entitled Chemicals for Industry, designed as an aid to both technical and non-technical men in the use of nitrocellulose, cellulose acetate, ethyl cellulose, sodium carborymethylcellulose, Parlon and Clorafin in plastics, films, lacquers, adhesives, varnishes, chlorinated rubber, etc. Booklet may be obtained from Hercules Powder Co., Wilmington, Del.

Formed Steel Tubes—A 32-page booklet, which was written mainly for product engineers, contains specifications for various tubing applications, and is profusely illustrated with both war and peace-time uses. Copies may be obtained from the Formed Steel Tube Institute, Cleveland, Ohio.

V-Belt Drive—Complete V-belt drive booklet (B6051E), which contains the required information to make correct drive selections reduced to charts, tables and drawings, may be procured from Allis-Chalmers Mfg. Co., Milwaukee, Wis.

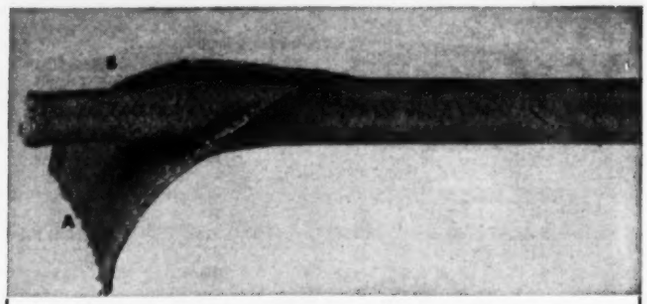
Thermal Insulation—Commercial Standard CS 117-44 based on more than two years of study by the Bureau of Standards is now obtainable from the Industrial Mineral Wool Institute, 441 Lexington Ave., New York 17, N. Y. It contains information on how to apply mineral wool in blocks, blankets, insulating cement and pipe insulation for all types of industrial equipment.

Lighting—Booklet for lighting engineers which features a set of charts containing illumination values based on various spacings and mounting heights is obtainable from Wabash Appliance Corp., 335 Carrol St., Brooklyn, N. Y. Also contained is information on reduction of maintenance cost and information on attaining peak lighting efficiency.

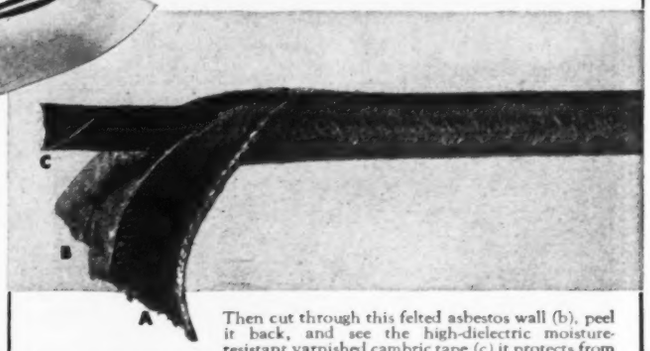
Resistors—Combination calender and resistor engineering guide which gives pertinent information regarding wire wound resistors (their use and application) may be obtained from Madison Electrical Products Corp., Madison, N. J.

Plastics—A technical bulletin, which lists and describes the results of dimentional stability tests on cellulosic plastics at high temperatures and high humidities, is obtainable from Cellulose Products Dept., Hercules Powder Co., Wilmington. Color sketches, photographs, tables and an explanation of the test conditions are included in the booklet.

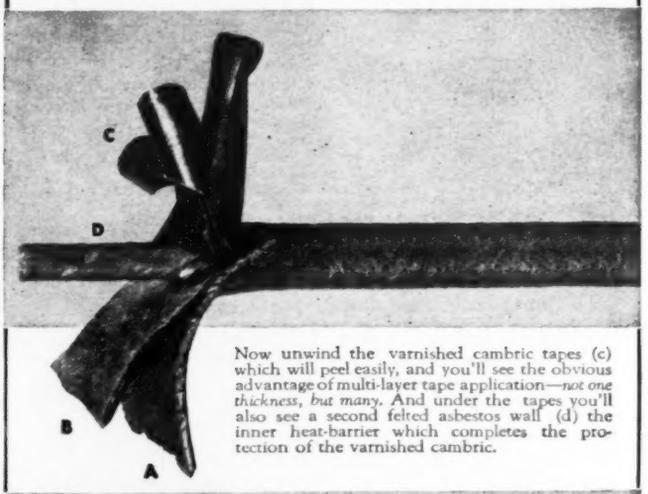
Slit It Open and SEE the Difference



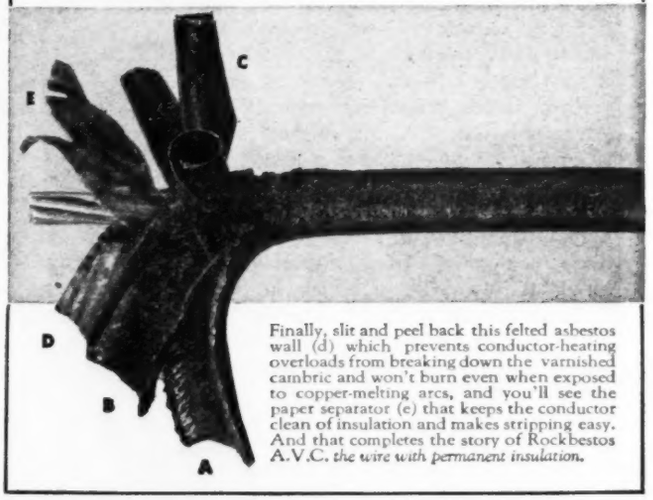
Take a sample of Rockbestos A.V.C. Power Cable, illustrated, or similarly insulated Motor Lead Cable, slit open the slick-finished heavy, heatproof, fireproof asbestos braid (a) which is resistant to moisture, oil and grease, and you'll find beneath a firewall of felted asbestos (b) a permanent heat-barrier against high ambient temperatures.



Then cut through this felted asbestos wall (b), peel it back, and see the high-dielectric moisture-resistant varnished cambric tape (c) it protects from heat, flame and oxidation. Notice too, the uniform coverage of the tapes, helically applied like the felted asbestos to assure perfect and permanent centering of the conductor in the insulation.



Now unwind the varnished cambric tapes (c) which will peel easily, and you'll see the obvious advantage of multi-layer tape application—*not one thickness, but many.* And under the tapes you'll also see a second felted asbestos wall (d) the inner heat-barrier which completes the protection of the varnished cambric.



Finally, slit and peel back this felted asbestos wall (d) which prevents conductor-heating overloads from breaking down the varnished cambric and won't burn even when exposed to copper-melting arcs, and you'll see the paper separator (e) that keeps the conductor clean of insulation and makes stripping easy. And that completes the story of Rockbestos A.V.C. *the wire with permanent insulation.*

Two important factors govern the selection of wire and cable for "hot-spot" service in steel mills, power plants and various vital industries. First, the conditions under which the circuits must operate, such as around soaking pits, boilers, furnaces, steam lines, drying ovens, rheostat grids; places where resistance to heat and moisture, corrosive fumes, oil, grease and even fire is essential. Second, and most important, is the construction of the wire—its in-built ability to stand up under these severe conditions.

Rockbestos A.V.C. Power, Motor Lead and Lighting Wires and Cables (National Electrical Code, Type AVA) meet the requirements of "hot-spot" service with permanent insulation that won't bake brittle, crack, bloom, swell or rot and has a maximum operating temperature rating of 110° C. (230° F.).

Apply the knife-test to a sample of Rockbestos A.V.C. and you'll find the answer to production losses and unnecessary maintenance due to wire-failure beneath the braid. Send for a sample and dissect it yourself. Rockbestos Products Corporation, 980 Nicoll St., New Haven, Conn.

ROCKBESTOS A.V.C.

The Wire with Permanent Insulation

122 different permanently insulated wires, cables and cords

ROCKBESTOS — PERMANENTLY INSULATED WIRES AND CABLES

developed by Rockbestos for various severe operating conditions

NEW YORK, BUFFALO, CLEVELAND, CHICAGO, PITTSBURGH, ST. LOUIS, LOS ANGELES, SAN FRANCISCO, SEATTLE, PORTLAND, ORE.

NEWS ABOUT PEOPLE

E. H. Werner Elected Head of New Jersey Utility

Edwin H. Werner, since 1941 president and general manager of the Pennsylvania Edison Co., Altoona, Pa., has been elected president and a director of Jersey Central Power & Light Co.,

Asbury Park, N. J. In his new position, he succeeds the late Thomas R. Crumley.

William H. Wade, vice-president and assistant general manager of the Pennsylvania Edison Co., has been elected senior vice-president and becomes the chief executive officer. At the same time Thomas R. Dobson was elected a vice-president and a director and P. H. Harris, president of the Pennsylvania Electric Co., Johnstown, was elected a director and chairman of the board of Pennsylvania Edison.

Prior to his connection with Pennsylvania Edison Co., Mr. Werner was vice-president and general manager of New Jersey Power & Light Co. from 1933 to 1936 and of Metropolitan Edison Co. from 1933 to 1941. He went to those companies from the Reading Street Railway Co. of which he was assistant general manager from 1923 to 1929 and president and general manager from 1929 to 1933. Previously he had been employed in various engineering capacities by Pittsburgh Railways, Reading Transit Co. and Bethlehem Steel Corp.

Mr. Werner has been active in the affairs of the Pennsylvania Electric Association for a number of years and in 1942 he was elected its president.

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► E. J. CROSBY, director of publicity of the Washington Water Power Co., Spokane, has relinquished his association with that utility to join the enterprises of his brother, Bing Crosby, in California.

•

R. A. Hentz Relinquishes Duties in Philadelphia

Robert A. Hentz, electrical engineer in charge of the electrical engineering division of the Philadelphia Electric Co., who has been disabled by ill health during the past sixteen months, has retired from active duty after more than 33 years of continuous service. Entering the engineering department of the company in 1911, as an electrical designer, he became assistant superintendent of the station construction di-

vision in 1919, and superintendent in 1925. At the time of the engineering department's reorganization in 1929, he was appointed electrical engineer.

Mr. Hentz has been active for many years in national electrical committee work including the Edison Electric Institute, the American Institute of Electrical Engineers and the Association of Edison Illuminating Companies, and has served as chairman in several cases.

Ontario Hydro Appoints Beacock Rural Engineer

Appointment of Victor A. Beacock as rural engineer in charge of rural operations throughout the province has been announced by the Hydro-Electric Power Commission of Ontario. This new appointment is the outcome of the commission's determination to vigorously

promote electrical service to rural Ontario as labor and material permit.

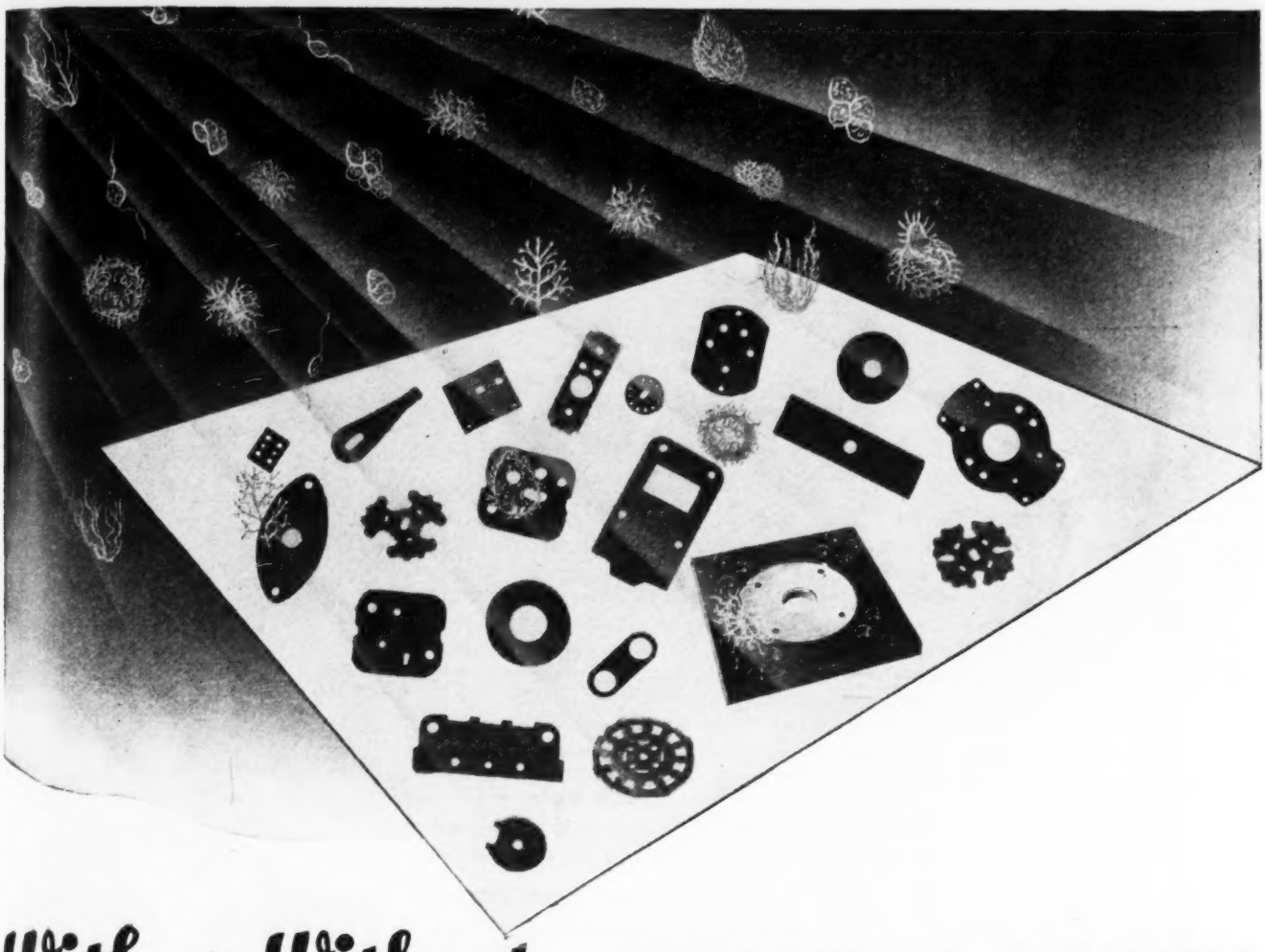
Mr. Beacock has a background of some thirty years of association with Hydro, broken only by his service in the last war. He joined the commission's staff in 1915 as assistant engineer in the municipal department, and following military service he rejoined the staff in 1919. Mr. Beacock is a graduate of the University of Toronto.

•

► M. S. COOVER, professor and head of the department of electrical engineering of the Iowa State College, Ames, has been elected president of the Iowa Engineering Society for 1944-45.

► BERNARD L. PALM will return to his position as commercial manager of the Central Illinois Public Service Co., Springfield, Ill., upon his retirement from the Army in April. Captain Palm will revert to inactive status, having served in the Army Air Forces for two and a half years.

► HOWARD N. WALTERS has been appointed director of industrial development by the B. C. Electric Railway Co., Vancouver, B. C. Mr. Walters has been connected with the company for a number of years. He has been on loan from the company to the National War Finance Committee. In his new office, Mr. Walters' duties will be to help industry find new products and to help new industries get started in areas served by the company. He will also



With or Without — PROTECTIVE FINISHES

. . . Insurok T-640 out-performs ordinary laminates!

So far as we know—there is no laminated phenolic plastic that has the *low moisture absorption* of Laminated INSUROK, Grade T-640! Scientific laboratory tests show it! On-the-job performance proves it! For in humid, tropical climates this Richardson Precision Plastic is daily showing its unique ability to outlast ordinary materials with *or without* protective finishes—in spite of devastating, ever-present fungus growths.

In addition, INSUROK T-640 has uniform dielectric and mechanical characteristics, and can be fabricated. With so many outstanding features, it's no wonder INSUROK T-640 shows up with increasing regularity today in specifications for radar, communications transmitters, receivers and many other products where moisture absorption must be cut to a minimum. Get the full story now! Write Richardson Plasticians today.

TESTS ON T-640—SANDED & UNSANDED
Made at Richardson Laboratories
Dec. 6, 1944

STOCK	T-640 SANDED	NOT SANDED
Thickness	.097	.126
Volatile	0.34%	0.29%
Moisture Abs.	0.56%	0.38%
Expansion	.0002	.0002
TESTS AT ROOM CONDITIONS		
Power Factor	.0322	.0333
Dielectric Constant	4.61	4.89
Loss Factor	.149	.162
Arc Test (Sec.)	130-128-129-126-123	129-60-117-12-64
TESTS AT 90% HUMIDITY 104° F.		
Power Factor	.0342	.0347
Dielectric Constant	4.77	5.06
Loss Factor	.163	.176
Insulation Resistance	122,000-98,000-122,000	98,000-162,000-122,000
Average	114,000	127,000

Insulation resistance was determined using taper pins. Sanded and unsanded samples were obtained from same factory sheet.

INSUROK *Precision Plastics*

The RICHARDSON COMPANY

MELROSE PARK, ILL. NEW BRUNSWICK, N. J. FOUNDED 1868 INDIANAPOLIS 1, IND. LOCKLAND, CINCINNATI 15, OHIO
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CLEVELAND OFFICE: 326-7 PLYMOUTH BLDG., CLEVELAND 15, OHIO

SAFETY

FOR LINEMEN WITH "KLEIN-KORD"

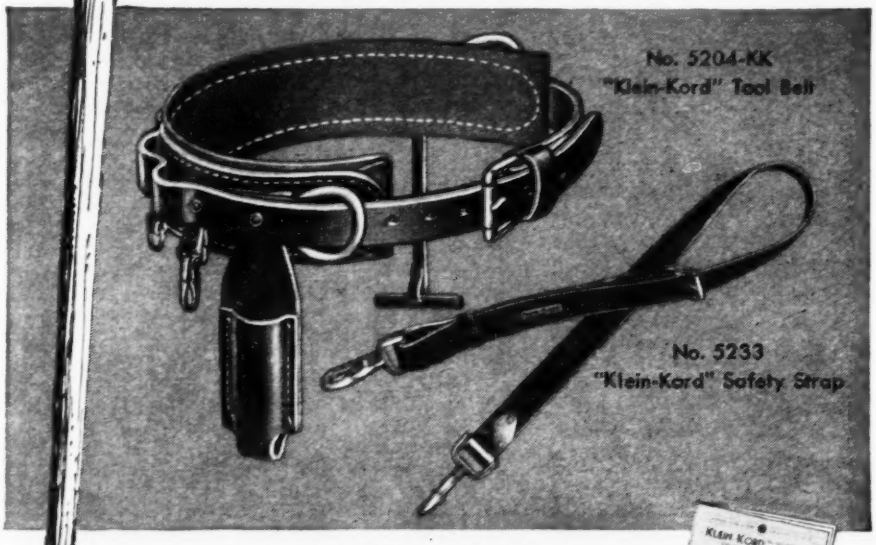
"Klein-Kord" is an exclusive material developed by Mathias Klein & Sons for use in linemen's safety straps, belts and climber straps.

It is made of a number of layers of long-staple cotton of special weave, each ply laid in rubber and vulcanized. This construction permits the use of a tongue buckle, eliminating the danger of slipping or excessive wear characteristic of a friction-type buckle.

The tensile strength of "Klein-Kord"—its resistance to ripping at the buckle—provides a full factor of safety. It does not stretch under load; is uniform in quality; and resists accidental damage from cuts, heat, etc.

"Klein-Kord" has behind it several years of actual service and today is specified exclusively by many of the largest utility companies.

Climbing equipment of "Klein-Kord" will assure the maximum in safety and comfort to the man on the pole.



ASK YOUR SUPPLIER

Foreign Distributor:
International Standard Electric Corp., New York

Safety engineers, purchasing agents and others interested in linemen's equipment can obtain a folder on "Klein-Kord" on request. Write for your copy.

KLEIN TOOLS EST. 1857

Since 1857

Mathias KLEIN & Sons
Established 1857 — Chicago, Ill., U.S.A.
3200 BELMONT AVENUE, CHICAGO 18, ILLINOIS

aid in the program of conversion from war to peacetime production of industrial plants. Mr. Walters will work directly under W. C. Mainwaring, vice-president in charge of general sales.

•

Copper Wire Group Names Barr Chief Engineer

Neil K. Barr has been appointed chief engineer of the Copper Wire Engineering Association with headquarters at St. Louis, Mo.

Following graduation from the University of Missouri, school of electrical engineering, Mr. Barr spent one year

in the engineering training course of the Commonwealth Edison and associated companies in Chicago. He then spent three years in distribution engineering work with the Kansas City Power & Light Co. in Kansas City, Mo.

For the past 16 years prior to joining the Copper Wire Engineering Association, he was with the Public Service Co. of Northern Illinois in various capacities on transmission and distribution engineering work.

•

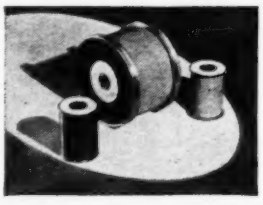
► L. J. VAVRINEK has been appointed chief engineer of the Benjamin Electric Mfg. Co., Des Plaines, Ill., to succeed P. D. PHILLIPS, who will serve as engineering consultant until his retirement this month. Mr. Vavrinek will be in charge of all operations of the engineering and product development activities of the company. He has been with the company since 1922.

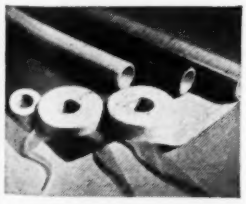
► PAUL B. MCKEE, president of Pacific Power & Light Co. and Portland Gas & Coke Co., Ore., has been made a member of the 1945 executive committee of the National Association of Manufacturers. Mr. McKee has been active as a member of the N.A.M. board of directors, a position he assumed in 1943. He was president of Emprezas Elec-

How many of these FIBERGLAS* ELECTRICAL INSULATION MATERIALS can you use to Advantage?

There is a Fiberglas Electrical Insulation Material available to meet virtually every insulation need. Fiberglas—glass in fiber form—provides a thin, strong, flexible, inorganic fabric base for insulating impregnants. This combination has unexcelled advantages and characteristics for electrical insulation.

Fiberglas Insulated Wire and Cable . . . Most wire manufacturers are currently manufacturing Fiberglas insulated wire of many different types for a wide range of applications—magnet wire, single and double covered, lead wire, radio hook-up wire, aircraft ignition cable, neon sign cable, and wires for special purposes are all in large volume production.





Fiberglas Varnished Cloth and Tape... Made by many manufacturers who impregnate various types of Fiberglas Cloth with several kinds of varnishes. These products are available in 36" widths or cut to any desired tape width.

Fiberglas Mica Combinations . . . The combination of thin glass cloths with mica for ground insulation is not dependent upon impregnating varnish for its electrical characteristics; the mica splittings provide dielectric strength while Fiberglas gives it strong inorganic backing.

Fiberglas Laminates . . . Most manufacturers of electrical laminates make one or more types of Fiberglas base materials. The finished materials are used in motors and generators as slot sticks, armature or stator end laminations, brush holders, space blocks, etc. The low power factor obtainable has resulted in increasingly wide use in radio and electronic applications.

Write for booklet . . . It tells what type to use, where and how. Send for your copy today, and ask for the name of the Fiberglas Electrical Insulation Materials supplier located nearest to you . . . Owens-Corning Fiberglas Corporation, 1858 Nicholas Bldg., Toledo 1, Ohio. In Canada, Fiberglas Canada Ltd., Oshawa, Ontario.

Each Distributor of Fiberglas-base Insulation Materials has his own source of supply; none of these processed insulations is made by Owens-Corning Fiberglas Corporation.

FIBERGLAS

*T. M. Reg. U. S. Pat. Off.

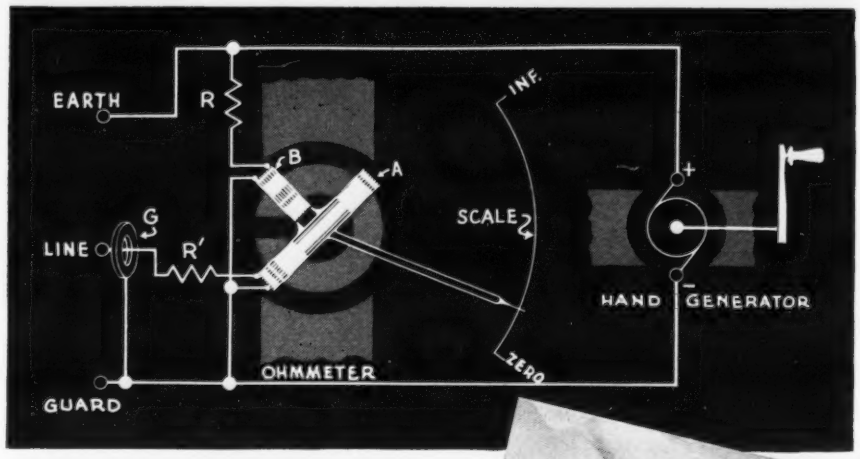
ELECTRICAL INSULATION MATERIALS

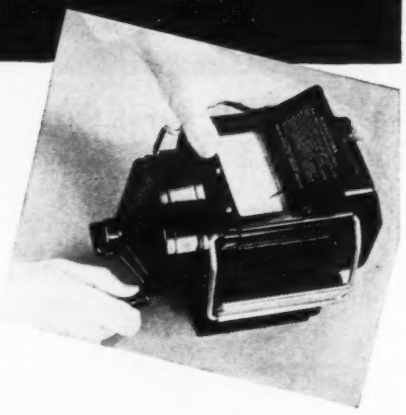
BE SURE TO SEE THE FIBERGLAS ELECTRICAL INSULATION MATERIALS EXHIBIT

THE NEXT SHOWINGS ARE: Hotel Statler, Buffalo, February 27-March 1; Biltmore, Dayton, March 7-9; Netherlands Plaza, Cincinnati, March 13-15; Hotel Henry Grady, Atlanta, March 20-21; Hotel Tutwiler, Birmingham, March 27-28.

Here's why—

"MEGGER"* Insulation Testers are always dependable—





In what we term a cross-coil true ohmmeter, two coils are mounted in fixed relation to each other on the same pivot-and-jewel moving system in the field of a permanent magnet. "Current" flows in coil A and "potential" in coil B, and they are connected so that their respective torques oppose each other. Since there are no control springs, the opposing coils give a true ratio of E/I, and ohms (or megohms) are indicated by a pointer over a scale. The readings are independent of the voltage of the hand-driven d-c generator, because any change in the voltage affects both coils in the same proportion.

The "Megger" instrument is simplicity itself. The circuit diagram shows *all* elements—hand-cranked generator, fixed resistance coils and ohmmeter with pointer and scale. Nothing more is needed and nothing could be simpler. In making resistance tests, you merely connect leads from the instrument to the apparatus or circuit under test, turn the crank for a few seconds, and read the insulation resistance directly on the scale.

Power generation and distribution practice has dictated certain standards of quality and performance that every piece of electrical equipment is expected to meet. "Megger" insulation testing instruments have been and will continue to be built in conformity with these high standards.

For complete descriptions and applications of all types of "Megger" Insulation Testers write for Catalog 1685-W.

**Trade Mark U. S. Pat. Off.*

JAMES G. BIDDLE CO. • **1211-13 ARCH STREET PHILADELPHIA 7, PA.**

tricas Brasileiras in Brazil from 1927 to 1933, and has since maintained a close interest in trade relations between the two nations.

•

Union Insulating Names Coughlin Sales Manager

Announcement has been made of the appointment of J. J. Coughlin, Jr., as sales manager of the Union Insulating Co., Inc., and J. H. Parker, covering

all of the Metropolitan New York district, as well as parts of New England up to Hartford, Conn.

Union Insulating Co. manufactures weatherproof sockets, Bakelite boxes and covers, Bakelite and porcelain insulator bushings. J. H. Parker has been a pioneer in porcelain. His concerns specialize in insulators and secondary racks, as well as ceramic products for the electrical industry.

•

► ROY HARMER has been appointed acting secretary of the Ontario Association of Municipal Electrical Utilities, succeeding the late S. R. A. Clements. Mr. Harmer is department engineer of the sales promotion department, Hydro-Electric Power Commission of Ontario.

► ROY WILKINS, well-known authority on 220,000-volt transmission line construction and prominent Pacific Coast utility executive, has joined the staff of engineering consultants of the Bonneville Power Administration. Mr. Wilkins, who was called from retirement in 1941 to supervise emergency power plant design for the Pacific Gas & Electric Co., previously had served the P. G. & E. for a number of years in various engineering capacity. In addition, he has been associated with General Electric Co., Schenectady, N. Y., Asociated Oil Co., Bakersfield, Calif., K. P. F. Electric Co., San Francisco, and the Pacific Electric Manufacturing Co., San Francisco, where he was vice presi-

[Advertisement]

SYLVANIA NEWS
CENTRAL STATION EDITION

MARCH *Published in the Interests of Better Sight and Sound* 1945

Prize-Winners Chosen in Sylvania Electric's First Fixture Design Contest for Utility Men

FIRST PRIZE:
C. J. BERRY, Consolidated Gas Electric Light and Power Company of Baltimore, Baltimore, Md.

THIRD PRIZE:
H. GRATTAN, JR., Potomac Electric Power Company, Washington, D. C.

Four major cash prizes and ten special awards were presented on February 7 to the winners in the first fixture design competition sponsored by Sylvania Electric Products Inc. The contest, open to utility lighting men, was planned to stimulate interest in improved designs of commercial fluorescent fixtures using four 40-watt lamps.

SECOND PRIZE:
L. B. PAIST, Northern States Power Company, Minneapolis, Minn.

FOURTH PRIZE:
WALTER KELLEY, JR., Blackstone Valley Gas and Elec. Company, Pawtucket, R. I.

CHARLES I. BRADY, JR.
Consolidated Edison Company, New York, N. Y.

E. B. BRANT
Florida Power Corporation
St. Petersburg, Fla.

A. W. BUDDENHAGEN
Central Hudson Gas and Electric Co., Kingston, N. Y.

W. W. BURKE, Public Service Company of New Hampshire, Manchester, N. H.

E. R. DAGGY
Public Service Co. of Northern Illinois, Glencoe, Ill.

W. N. HARRISON
Philadelphia Electric Co.
Philadelphia, Pa.

W. C. MACY
Pacific Gas and Elec. Co.
San Francisco, Cal.

T. M. RICHARDSON, 3RD
Oklahoma Gas and Elec. Co.
Oklahoma City, Okla.

VERNON T. SWAIN
Central Maine Power Co.
Waterville, Me.

G. A. TROSPER
Pacific Gas and Electric Co.
San Francisco, Cal.

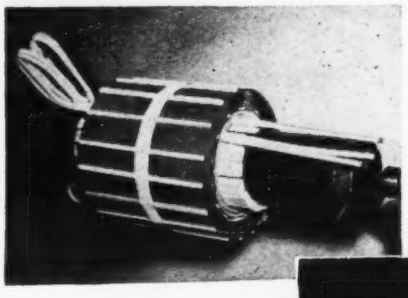
SYLVANIA ELECTRIC
SYLVANIA ELECTRIC PRODUCTS INC., Salem, Massachusetts
MAKERS OF FLUORESCENT LAMPS, FIXTURES, ACCESSORIES; INCANDESCENT LAMPS; RADIO TUBES; CATHODE RAY TUBES; ELECTRONIC DEVICES

NO. 3 OF A SERIES ON THE *Service Superiority* OF

DAVIS TRANSFORMERS

Safety

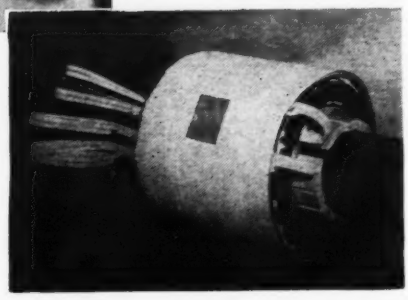
Safety to life and property is the first consideration in the design and construction of Davis Transformers. Davis Transformers have been manufactured since 1935 and have won a name for themselves because of their in-built safety, reliability and efficiency. Into their production we put the practical experience gained thru years of repairing and rebuilding Transformers of EVERY MAKE, size and voltage. This experience enables us to SAFEGUARD Davis Transformers at those points where failures usually occur.



Winding DAVIS 37½ KVA, 2400-120/240 volt transformer

The points at which the insulation is most important to the lives and safety of those who must or may come in contact with the equipment are between high voltage and low voltage windings and between windings and case.

The insulation at these points consists of a pad of a plurality of kinds of insulating materials, each of which has been carefully selected for its ability to perform a particular function.



NOTE QUANTITIES OF INSULATION

TRANSFORMER *Service* FOR YOUR BENEFIT

- For years we have been "transformer repair headquarters" for leading utilities and industrial companies. We offer complete repair and rebuilding service. All work guaranteed same as that of original manufacturer. A large stock of used transformers for sales — similarly guaranteed. Write us.

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Manufacturers of Oil Cooled, Dry Type, Power and Distribution Transformers
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Tel. Underhill 4830

dent in charge of engineering. He is a fellow of the American Institute of Electrical Engineers and is a member of the American Society of Mechanical Engineers and SEV, Swiss engineering society.

•

General Electric Makes Organization Changes

Several organization changes within the General Electric Co.'s New York district have been announced. G. H. Reid is appointed assistant district manager. W. E. Brown has relinquished his position as manager, central station division, but will remain to handle special assignments. H. M. Sliter has been made district manager of the central station division, and R. M. Darrin assistant district manager of this division. Horace Zimmer has been appointed district manager of the industrial division, which is in addition to his present position of district manager, transportation division and H. M. Bardin has been named manager sales of the federal and marine section, which has been transferred from the transportation to the industrial division. R. B. Ransom has been made manager of the New Haven office, and J. J. Pascher will manage the Hartford office.

Harry E. Dunham, for the past 15 years assistant manager of the company's patent department, has been appointed manager. Harry R. Mayers, formerly in charge of a section of the government division in the electronics department, has been made assistant manager of the patent department.

Four new appointments in General Electric Co.'s meter and instrument division were recently announced by E. H. Howell, division manager. They are: Richard Cutts, Jr., manager sales, meter section; E. J. Wehrle, manager sales, and R. H. Mitchell, assistant manager sales, electric instrument section; and E. J. Boland, manager sales, aircraft instrument section, all with headquarters at the West Lynn Works.

E. L. Feininger of Schenectady and William H. Milton, Jr., of Pittsfield have been named assistant general managers of the recently organized chemical department. Headquarters for the new department are in Pittsfield, where the plastics divisions, in charge of Mr. Milton, are now located. Mr. Feininger will continue to make headquarters in Schenectady and will be in charge of the resin and insulation materials division. Other chemical department appointments include Don S. McKenzie, of Pittsfield, as general sales manager and Robert L. Gibson of Schenectady as advertising and sales promotion manager.

Howard K. Smith, formerly in the

WARD LA FRANCE

THE FINEST HEAVY-DUTY TRUCKS MONEY CAN BUY

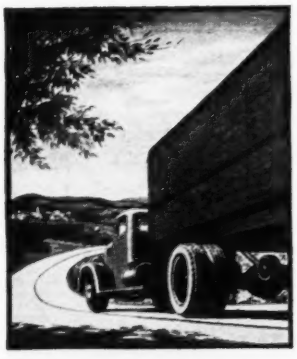
For over twenty-five years, Ward LaFrance has been building a traditionally fine line of heavy-duty motor trucks. Each successive year has brought advances in design and engineering. Today's Ward LaFrance is better than ever.

The finest Ward LaFrance trucks ever built are now serving the United Nations all over the world. They are the huge, type M-1 Heavy Duty Wreckers which have compiled an unbeatable record for stamina and dependability.

Postwar Ward LaFrance trucks and over-the-road tractors, both gasoline and Diesel, offer fleet owners the opportunity for the most efficient hauling in trucking history . . . Write our Sales Department for the Ward LaFrance fleet-owner plan.

FRANCHISES AVAILABLE

Progressive, merchandising-minded concerns eager to expand their profit possibilities by broadening their market potentials, would do well to consider the fertile, heavy-duty truck market. Investigate the profit potential in the Ward LaFrance line . . . Our Sales Department will be happy to supply information about available franchises.



WARD LAFRANCE

TRUCK DIVISION

GREAT AMERICAN INDUSTRIES, INC.

ELMIRA, NEW YORK

starts 'em hot... stops 'em cold

for 30, 40 and 100 watt lamps

THE principal function of a high quality starter is to provide accurate starting of good lamps and positive stopping of dying lamps. And that's what G-E Watch Dog Starters give you.

In addition to other tests, every Watch Dog must light a fluorescent lamp within a few seconds. It's also a precision stopper. When a lamp reaches the end of its useful life, blinking and flickering start but the Watch Dog stops them immediately and positively. Since the Watch Dog cuts itself out of the circuit, this annoying condition cannot possibly recur.

The Watch Dog's precision starting and stopping not only prolong the life of the starter but protect ballasts and reduce maintenance costs. Install G-E Watch Dogs and enjoy economical and efficient fluorescent lighting service.

For additional information write to Section G352-9, Appliance and Merchandise Dept., General Electric Co., Bridgeport, Conn.

BUY WAR BONDS AND KEEP THEM

★

Hear the General Electric radio programs: "The G-E All Girl Orchestra" Sunday 10 P.M. EWT, NBC. "The World Today" news every weekday 6:45 P.M. EWT, CBS.

GENERAL ELECTRIC

federal and marine divisions of the apparatus department has been appointed assistant to A. A. Brandt, general sales manager, electronics department.

D. B. Fisk has been appointed section engineer on recording, electronic and telemetering instruments at the West Lynn (Mass.) Works of the company, and R. W. Snyder has been named design engineer on certain types of gyroscopes at the West Lynn factory, following an extended period of service in the demand meter and gyro fields.

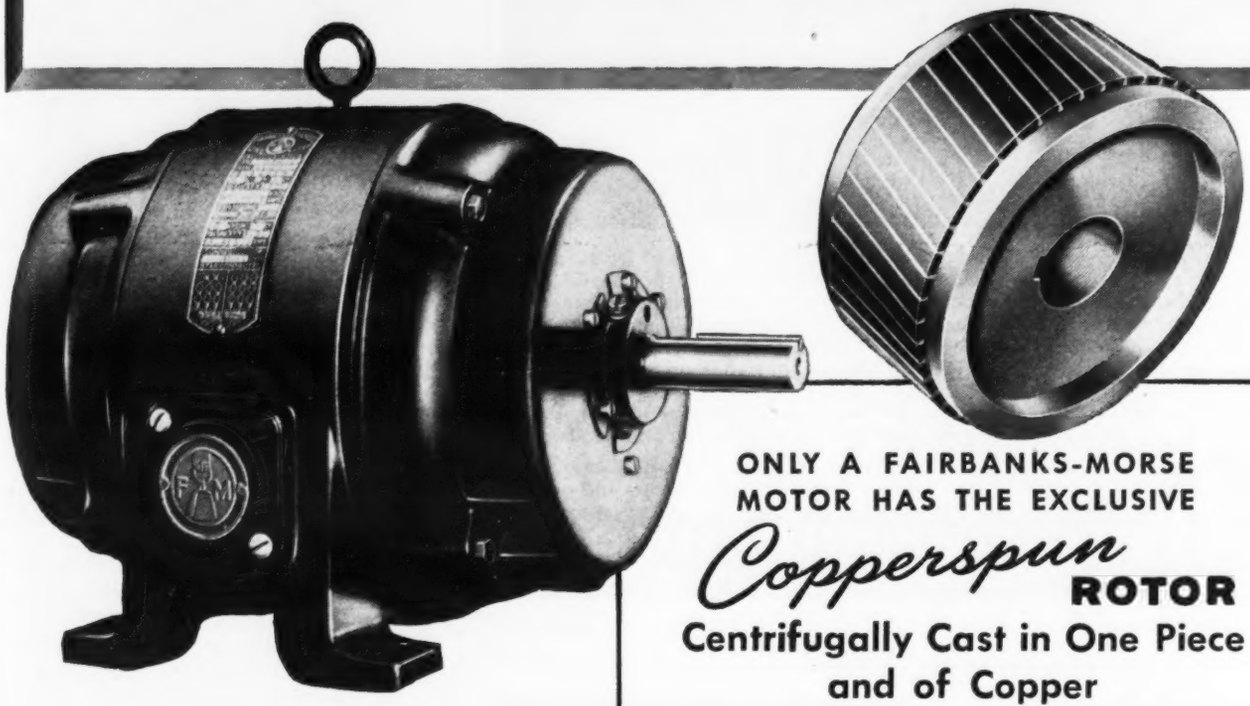
▶ KENDALL A. REDFIELD, assistant general sales manager and advertising manager of the Rockbestos Products Corp., New Haven, Conn., has resigned to become president and general manager of Associated Seed Growers export division. During his association with The Rockbestos Products Corp. Mr. Redfield was at first in charge of sales promotion, later appointed advertising manager and since 1935 had been assistant general sales manager of the company. EDWARD M. HEERY, assistant advertising manager, advanced to the position of advertising manager. ROBERT B. LATTIN, formerly factory manager, assumed the newly created position of technical director and STEPHEN S. NICHOLS, formerly assistant factory manager, was made factory superintendent.

▶ ORVILLE L. EVANS, manager of the Dover district of the Public Service Co. of New Hampshire, has been appointed manager of the eastern division recently established by the company with headquarters at Dover. The new division includes the former Dover and Pittsfield districts, the floating steam plant "Jacona", and the several steam and hydroelectric generating stations in the Somersworth-Salmon Falls area. HERBERT D. WENTWORTH has been named station superintendent of the division, having previously been assistant superintendent of stations in the Dover area.

▶ WILSON A. CHARBONNEAUX is now manager and chief engineer of Automatic Control Engineers, Burlington, Iowa, development engineers and manufacturers of electrical power plant control equipment. Mr. Charbonneaux was formerly associated with Burlington Instrument Co., Burlington, Iowa, for eight years as chief engineer and general manager.

▶ A. E. SNYDER has been elected president of the Polarized Products Corp., a wholly owned subsidiary of the Noma Electric Corp. Some few years ago, Mr. Snyder was general sales manager of the lamp division of Westinghouse Electric & Manufacturing Co.

A BETTER ROTOR
A BETTER MOTOR



ONLY A FAIRBANKS-MORSE MOTOR HAS THE EXCLUSIVE

Copperspun **ROTOR**

Centrifugally Cast in One Piece and of Copper

It took *years* to develop the Fairbanks-Morse centrifugally-cast, one-piece copper rotor. But it's worth it. Reduced operating costs and longer, more dependable service are the results.

But those aren't the only advantages you get in a Fairbanks-Morse Motor. There's a long list of other features that all add up to *better* service for you. Note the list below. That's why we call it tomorrow's motor today.

Check List of Plus Features

Protected Frame— Dripping liquids and falling particles excluded in any mounting position.

Symmetrical Design— Reversible frame provides for locating conduit box on either side. Bearing arms can be mounted in any one of four positions 90° apart.

Crossflow Ventilation— Another exclusive feature in frames 224 to 365 inclusive. Air moves in both directions, providing a motor of uniform temperature. No hot spots.

Recessed Conduit Box— An innovation for neat installations. Choice of conventional box or frame recess with cover flush with frame.

Balanced Characteristics— Motor rated 40°C with high efficiency and power factor and excellent starting and accelerating torques.

Ball Bearings— Sealed in and protected.

Write for information, Fairbanks, Morse & Co., Fairbanks-Morse Building, Chicago 5, Illinois.

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A name worth remembering

Diesel Locomotives • Diesel Engines • Generators • Motors • Pumps • Scales
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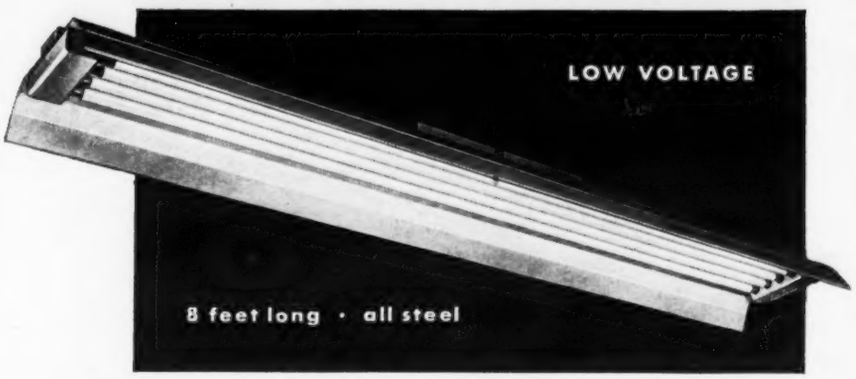
*COLOVOLT COLD CATHODE INDUSTRIAL FIXTURES



Here is the new Colovolt industrial fixture, one of a complete line of industrial and commercial "packaged" units. Equipped with the standard 93" Colovolt 10,000 hour lamp, Colovolt fixtures may be used singly or in continuous line lighting in multiples of 8 feet. Instantaneous starting, no flickering, guaranteed for 1 year except for failure due to breakage are extra advantages of the Colovolt Cold Cathode low voltage fluorescent lamp. The long life expectancy of Colovolt lamps may be realized even when constantly turned on and off, and *pre-scheduled re-lamping, with no loss of production or time, is now possible with Colovolt installations.*

*Trade mark registered U. S. Pat. Off.

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For **NIGHT REPAIRS** and **LINE PATROL**

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LINEMEN'S FLARE LIGHTS

An efficient, economical form of portable illumination — giving daylight vision for night repairs and line patrol work. Unaffected by wind, rain or snow. Two sizes —20 or 30 minute lighting periods.

Central Linemen's Flare Lights are invaluable during outages or other emergencies when quick, dependable illumination is imperative. Easily lighted in any weather by self-contained friction cap. No matches required. Stick in a post, tree, cross arm, in the ground or carry by hand.

They're always ready, and provide ample illumination. Standard equipment with prominent utilities throughout the land.

STANDARD PACKING

No. 3020-20 min., per case of 72....$12.00
No. 3030-30 min., per case of 36.... 9.00

CENTRAL RAILWAY SIGNAL COMPANY, INC.
272 CENTER STREET, • NEWTON 58, MASS.
Plant Locations: HAMMOND, IND.; NEEDHAM HEIGHTS, MASS.

OBITUARY

Charles F. Norton

Charles F. Norton, formerly sales manager for the Louis Allis Co., Milwaukee, died February 11 at his family home near Alhambra, N. Y. He was 60 years old. Mr. Norton was connected

with the Milwaukee firm from May 1, 1933 to January 15, 1943 when ill health forced him to retire.

Before joining the Louis Allis Co. he was vice-president and general manager of the Howell Electric Motor Co. of Howell, Mich., an organization which he helped to form after graduating as an electrical engineer from Purdue University.

Mr. Norton was widely known in the electric motor field, having served on national committees of the National Electrical Manufacturers Association.

•

▶ FRANK D. EGAN, superintendent of the electrical department of Bethlehem Steel Co.'s plant at Lackawanna, N. Y., for twenty years before his retirement two years ago, died on February 17 at the age of 61. Mr. Egan was a past-president of the Association of Iron and Steel Electrical Engineers. He was born at Frostburg, Md., and was educated at the University of Pittsburgh. He was associated with the National Tool Co., the Pittsburgh Crucible Steel Co. and the Pittsburgh Iron & Steel Foundries Co. before affiliating himself with the Westinghouse Electric & Manufacturing Co. in 1919, in all of these connections directing his attention to the development of electrical apparatus for steel-mill application. He joined Bethlehem Steel in 1922.

▶ RALPH STODDARD, president and treasurer of the De Laval Separator Co., and an officer of its several subsidiaries, died of a heart ailment on February 20 at his home in New York in his seventy-sixth

TROUBLE PREDICTED

COMPLAINTS FORESTALLED

DEFECTS REVEALED

Bristol's All-Purpose Portable Voltmeter gives you a convenient means of quickly analyzing conditions, making voltage surveys, general testing, investigating complaints — helping you to maintain a high standard of voltage regulation.

Double-record Voltmeters help check the balance on three-wire systems and to study voltage drop in a section of the circuit.

Three-record Voltmeters are used in investigating conditions in three separate circuits or in polyphase networks, and for determining voltages at load centers and ends of feeders.

BRISTOL'S ALL-PURPOSE PORTABLE VOLTMETER

Easy to handle — weighs only 17 pounds. Can be carried anywhere, mounted anywhere — outdoors or on a damp cellar floor. Will take constant handling without affecting accuracy.

Bulletin E1100 describes replaceable measuring element, gravity-controlled pen pressure, fine-bore platinum-tip fountain pens, integral resistors. Address THE BRISTOL COMPANY, 116 Bristol Rd., Waterbury 91, Conn. (The Bristol Co. of Canada, Ltd., Toronto, Ont. Bristol's Instrument Co., Ltd., London, N. W. 10, England). Makers of Metameter, Recording Ammeters and Voltmeters, Thermoverter, and a broad line of automatic controlling and recording instruments.

BRISTOL

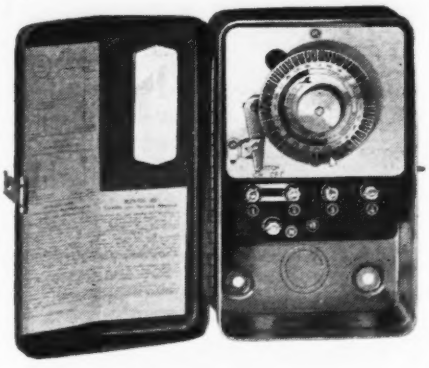
Gives You the Facts when and where you want them

AUTOMATIC RECORDING AND CONTROLLING INSTRUMENTS

AMERICA'S "TOPS" IN TIME SWITCH PERFORMANCE

Mr. "Tops," the Paragon symbol of top quality

. . . an accurate, durable self-lubricating time switch for controlling stokers, oil burners, blowers, pumps, valves, air conditioning, etc. . . . . for only $13.00 list.



JUST TWO EXPOSED GEARS. All others constantly lubricated because they operate in a sealed oil bath.

DUST PROOF. Because of the sealed-in features, dust has no effect upon the operation.

SLOW SPEED MOTOR. The first and only low priced Time Switch to be timed and operated by slow speed (450 R.P.M.) industrial type self-starting synchronous motors.

FOR LOW TEMPERATURE. Guaranteed to operate successfully at temperatures as low as 20 degrees below zero.

SELECTION OF SWITCHES. Switches available: single pole single throw, double pole single throw or single pole double throw.

Send for complete engineering bulletin. Paragon manufactures a wide range of industrial timers, time delay relays, panel boards and other electrical equipment.

PARAGON ELECTRIC COMPANY
703 OLD COLONY BUILDING
CHICAGO 5, ILLINOIS

Paragon Chicago
BUILDERS OF ELECTRICAL EQUIPMENT SINCE 1905

year. A native of Poultney, Vt., Mr. Stoddard became associated with his father, the late Marvin O. Stoddard, in the manufacture of dairy equipment and in 1907 went to New York as an executive of the De Laval companies. He became president of the Separator company in 1942.

•

John V. McKinney

John V. McKinney, president and director of the Iowa-Illinois Gas & Electric Co., Rock Island, Ill., since its formation in 1942, died at his home on January 27. Mr. McKinney was born in Sterling, Ill., in 1893 and was graduated from the University of Wisconsin. Following military service in World War I, he became identified with the Milwaukee Electric Railway & Light Co., later with Elston & Co. and then with Northern Iowa Gas & Electric Co. In 1921 he became associated with William G. Woolfolk & Co., consulting engineers of Chicago. This connection took him to Kansas City with the organization of the Kansas City Public Service Co. and during his seventeen years with that company he served as assistant to the president, and later as executive vice-president. From this position he was called to the presidency of the Iowa-Illinois utility.

•

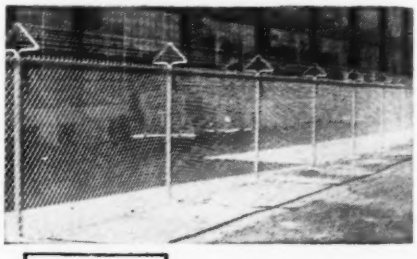
▶ JOE BRENNAN, 61, vice-president of the Memphis (Tenn.) Light, Gas and Water Division died on February 19, at his home in that city where he was stricken with a sudden heart attack. Mr. Brennan was a life long resident of Memphis. He was a member of the Park Commission eight years and chairman five of these years. He resigned that position in 1940 to devote his full time as commercial manager of the Light, Gas and Water Division and was later promoted to vice president.

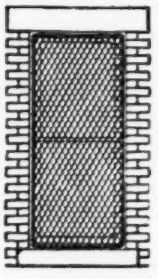
▶ W. J. JEANDRON, who was identified with the early development of carbon brushes, died in Orange Memorial Hospital, Orange, N. J., on February 4 after a long illness. In 1905 Mr. Jeandron was made agent in North America of the French company of Lacombe & Cie, later Societe Le Carbone Lorraine, carbon brush manufacturers. In later years an American corporation, Le Carbone Company was formed, with Mr. Jeandron as treasurer to process the finished products in the United States. He retired in 1936.

▶ CHARLES A. RUSSELL, who retired in 1941 after many years as patent attorney for the SKF Industries, Inc., of Philadelphia, died at his home in Rahway, N. J. He was 73 years of age.

THIS FENCE MAKES IT TOUGH TO GET IN OR OUT WITHOUT DETECTION

Stewart 5TH Non-Climbable Chain Link Wire Fence, shown in the illustration below, assures the utmost in protection because getting in or out except through designated areas is practically impossible. Although restrictions still preclude the manufacture of many products, Stewart Chain Link Wire Fences, Window Guards, Wire Mesh Partitions, and Steel Folding Gates are available NOW for certain protective purposes. If your property is unprotected, don't take chances—write us about your requirements. We'll be glad to send complete information. The Stewart Iron Works Co., Inc., 1201 Stewart Block, Cincinnati 1, Ohio.





WIRE WINDOW GUARDS

Stewart Wire Window Guards are made to fit any size or shape opening. Available NOW. When writing for information please give all measurements involved.

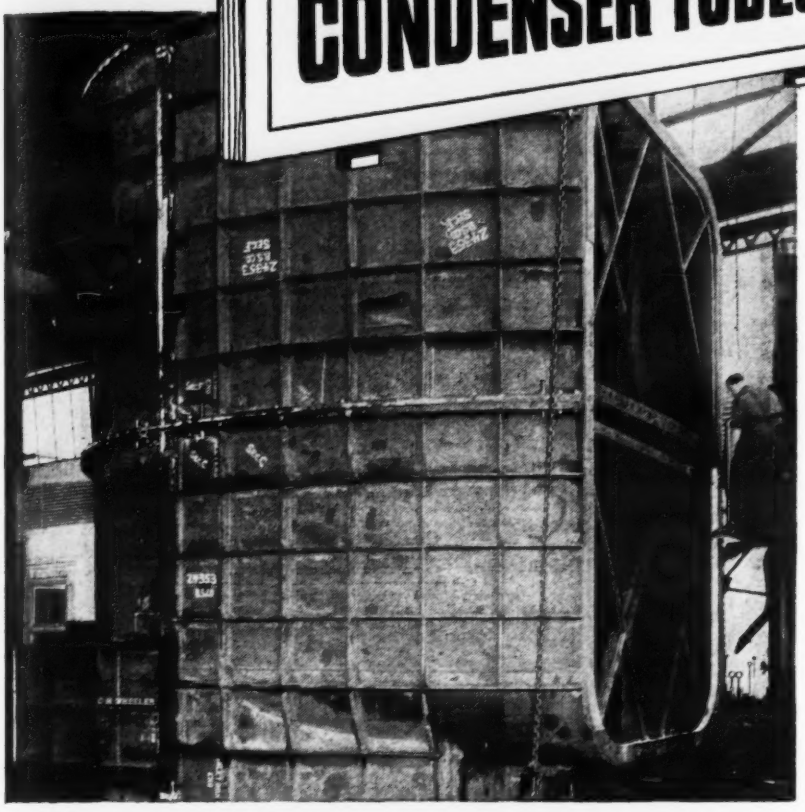
WIRE MESH PARTITIONS

Available NOW. Sectional—made to fit any height or width. Easily and quickly installed. When writing please give measurements and anchorage conditions.

Stewart IRON and WIRE FENCES

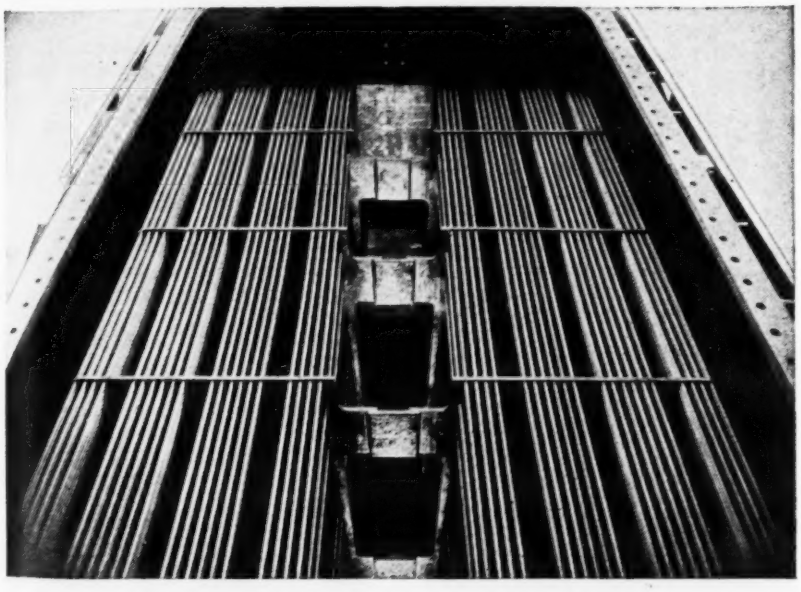
36½ MILES OF CONDENSER TUBES

... and every inch must be the same!



Above, Shell for 50,000 square foot surface condenser fabricated by C. H. Wheeler Manufacturing Company.

Below, Anaconda Muntz Metal Tubes, as seen through exhaust opening.



Eighty-four hundred lengths of Anaconda Muntz Metal Condenser Tubes provide 50,000 square feet of surface area in this public utility condenser fabricated by the C. H. Wheeler Manufacturing Company.

In the construction of such huge and costly units as this, involving quantities of priority material, selection of the correct tube alloy is of prime importance.

That is why manufacturers of condensers and heat transfer equipment so often confer with Engineers of our Technical Department . . . why Anaconda Condenser Tubes are available in a wide range of alloys.

The experience gained in years of study of tube metallurgy and performance under a wide range of operating conditions, in power plants, refineries, at sea, and ashore in all sections of the country is at your disposal. Publication B-2 lists Anaconda Condenser Tube Alloys, describes their manufacturing processes, compositions and fields of application. We'll be glad to send you a copy. 44101

THE AMERICAN BRASS COMPANY
Subsidiary of Anaconda Copper Mining Company
General Offices: Waterbury 88, Connecticut

In Canada: ANACONDA AMERICAN BRASS LTD., *New Toronto, Ont.*

ANACONDA
from mine to consumer

Anaconda Condenser Tubes

MANUFACTURING MARKETS

Borg-Warner Official Hits OPA-Pricing

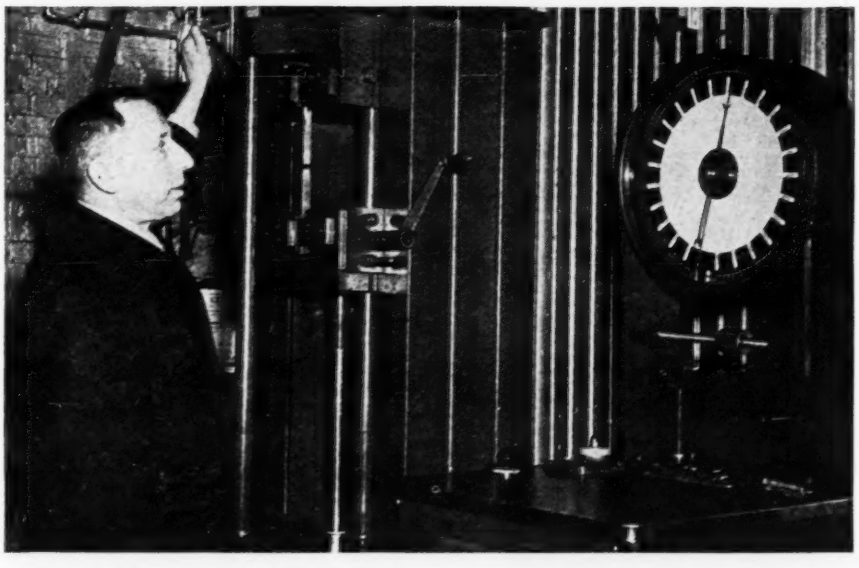
Government should not be permitted to extend "discriminatory or socialistic" favors to any types of business, particularly cooperative merchandising organizations, Howard E. Blood, president of the Norge division of Borg-Warner Corp., asserted in an address delivered at the American Management Association's finance conference.

He spoke of the overall subject of government pricing policies, which, he declared, in too many cases are "causing businessmen to feel helpless and to stand mute." The Office of Price Administration's "publicly announced profit squeezing intentions" together with the government attitude toward "co-ops" are "the most generally important present phases of government controls in industry pricing."

Mr. Blood explained that he was not opposed to cooperatives, but felt they should be required to "play the game to the same rules as other forms of manufacturing and distribution" organizations. He said, however, that they are a form of competitive private business and for government to provide them with capital and grant them special tax favors "will tend to drag other business down to the government owned and patronized level, and to become an increasing burden on all of those who still pay taxes.

"For co-ops to get a large part of their capital from excessively long government loans at practically no interest puts government capital into competition with private business. And for government to favor co-ops in taxes adds to a trend to socialize business."

"Let's get some sense into this question of post-war prices of durable consumer goods, and any other goods similarly mishandled by OPA," said Mr. Blood. "Price ceilings should be held on such scarce goods at a point which absorbs the unavoidable increases in cost and prevents the inflation of profit margins but does not eliminate nor substantially reduce the profit margins. Under such a general policy business could go ahead with that confidence which must be created if we are to see the bold and swift reconversion we all want. . . ."



MULTI-PURPOSE TESTING MACHINE—Replacing three other types of equipment at the Research Laboratories of the Okonite-Callender Cable Co., Paterson, N. J., is this S-60 Universal hydraulic testing machine which is able to measure the following characteristics: soundness of cable sheath welds, tensile stress, modulus of elasticity, elongation and ductility, compression, Brinnell hardness, bending, sheer and uniformity. The machine can be used for testing metals, fabrics, plastics, paper and rubber-like materials

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Philco-M.I.T. Plan Electronics Course

Plans for a professional course in electronics, emphasizing applications to television and highly developed production methods in which the Philco Corp. of Philadelphia will cooperate, have been announced by Dr. Karl T. Compton, president of the Massachusetts Institute of Technology.

"Twenty years' progress has been made in the field of electronics during the war emergency," Dr. Compton declared in announcing the new course. "Tremendous opportunities will exist in all phases of electronics in applying wartime developments to the arts of peace, and the primary purpose of this new course of study will be to combine instruction in advanced theory at M. I. T. with work in the plants of one of the leading companies in design and production of electronic equipment."

Under the new cooperative course, which follows a plan established at the Institute many years ago, leading to the master of science degree, a selected group of students in the department of electrical engineering will spend alternate terms at the Institute and at the Philco plants.

The new course is established as an option in the department of electrical engineering, which has conducted parallel courses for more than 25 years in conjunction with the General Electric Co., American Telephone & Telegraph Co., Boston Edison Co., Boston Elevated Railway, and the General Radio Co.

The new course will be under the general direction of Prof. W. H. Timbie.

•

Belden Sales Increase, Unfilled Orders Mount

Sales of the Belden Manufacturing Co., Chicago, during 1944 totaled approximately $11,263,000, a small increase over the previous new high established in 1943. Unfilled orders amount to eighteen weeks billing at the current rate of operation. H. W. Clough, vice-president, forecast shipments in the first quarter will exceed the comparable period of 1944.

Directors of Beldon have recently declared a dividend of 30 cents a share payable March 5 to stock of record February 17.

G-E 2-WAY FM RADIO

makes utility maintenance more effective

In fair weather or foul, on any location throughout your circuit mileage, a maintenance truck is never alone when equipped with a G-E 2-way FM radio. It provides each crew with the means for reporting existing conditions back to the dispatcher, for getting help fast, for communicating with other crews on the same job, and for getting new assignments. Two-way radio can bring your maintenance facilities under finger-tip control.

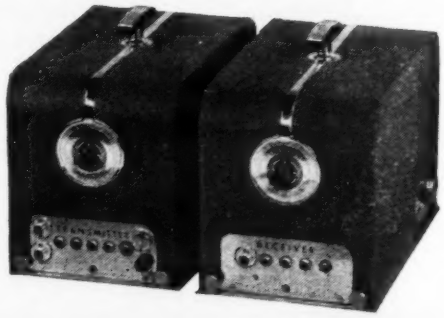
A G-E 2-way FM radio system will give you reliable, long-range communication under the most adverse conditions, day and night. It will enable maintenance crews to serve wider areas in less time and at lower cost. It will help improve your service.

In serving your radio-communication needs, G.E. offers you the same specialized attention that is extended to you in your power-distribution and maintenance requirements. Call your G-E sales engineer when you discuss your communication problems. He will have a specialist assist in planning the most effective system for your installation. *Electronics Department, General Electric, Schenectady 5, N. Y.*

Write for these booklets: "G-E FM Communication System Guide" gives you practical facts about the selection of 2-way FM radio and will assist you in estimating total installation costs. "G-E FM Communication Equipment Catalog" describes and illustrates the required units and accessories.

Hear the G-E Radio programs: *"The World Today" news, Monday through Friday, 6:45 p. m., EWT, CBS. "The G-E All-Girl Orchestra," Sunday 10 p. m., EWT, NBC. "The G-E House Party," Monday through Friday, 4 p. m., EWT, CBS.*

Government regulations now permit new installations of 2-way FM radio for important requirements of utility companies. Let your G-E representative help you prepare your applications.



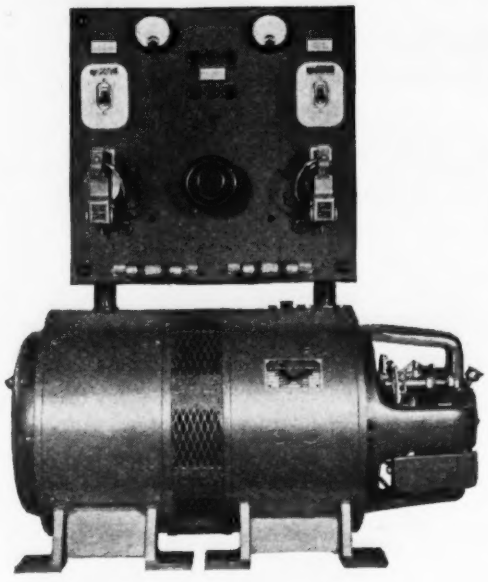
Everything for 2-way radio communication

GENERAL ELECTRIC

163-D6-6918

THE DIVERTER POLE CHARGER

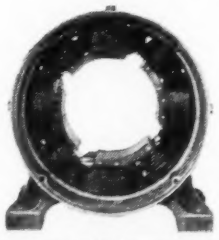
Keeps Any Standby or Control Battery At Peak Efficiency —AT ALL TIMES . . . Insures Maximum Battery Life and Reduces to a Minimum Battery Charging Costs.



The Electric Products DIVERTER POLE Generator Sets, wherever installed, have universally earned the approval and confidence of Utilities engineers, for charging Standby and Control Batteries, because of the inherent characteristics to stay on duty at all times providing automatically, a safe, controlled floating charge.

Some of the Diverter Pole inherent characteristics that insure most efficient performance are:

- It constantly provides a *closely regulated charging rate* enough to compensate for losses and maintain the battery in a healthy fully charged condition.
- The Diverter Pole Generator *is fully automatic in operation* eliminating manual attention to charging and requiring only periodic inspection.
- By inherently shifting all loads, beyond the safe capacity of the generator on to the battery the Diverter Pole *protects itself at all times*, yet is able to share with the battery these surge load requirements up to safe generator capacity.
- It is inherently protected against any characteristics of "running away" or reversal of polarity.



Diverter Pole Construction

These inherent characteristics plus the special design, careful construction and thorough field tests have insured maximum battery efficiency and life at minimum maintenance costs.

Write for Bulletin No. 966-A

The Electric Products Co.
1731 CLARKSTONE ROAD · CLEVELAND 12, OHIO

Manufacturers Make Sales Assignments

Electrical manufacturers have recently made the following appointments to their sales staffs:

Royal Electric Manufacturing Co., Chicago has appointed Dan S. MacCorkle with offices at 50 Church Street, New York, as representative in that district.

Triangle Conduit & Cable Co., Inc., has appointed Edson L. Harris, 5038 31st Avenue, Minneapolis 6, Minn., as district manager of Wyoming, Montana (east of and including Billings), North and South Dakota, Wisconsin, Minnesota, Michigan (north of Lakes Huron and Superior), Iowa (north of a line drawn from Sioux City to Dubuque and including those two cities), under the supervision of Horace E. Fritschle, mid-western district manager, Chicago.

Bridgeport Brass Co. has appointed Alfred G. Mohrman manager of the New York district. He was formerly assistant manager.

Pacific Electric Manufacturing Corp., San Francisco, has named Walter E. Thompson, 447 Martin Bldg., Birmingham 3, Ala., sales representative, and also J. D. Williams, 316 Louisiana St., Little Rock, Ark., and J. D. Brosman, 426 Investment Bldg., Washington 5, D. C.

Schweitzer & Conrad, Inc., Chicago, has announced the appointment of Hoffman Supply Co., Albuquerque, N. M., as area correspondent in New Mexico, Arizona, and El Paso County, Tex.

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Maritime Services Take Half Westinghouse Output

Almost one-half of the total production of Westinghouse in 1944, in terms of dollar value of equipment, was designated for the ships of our Navy and Merchant Marine. More propulsion turbines and gears for merchant vessels were shipped last year than were built by the company in all years prior to 1943—and 1944's production of propulsion turbines for cargo vessels, tankers and transports was approximately 250 percent of that in 1943. Over 5,000,000 hp. will be developed by all of the turbine drives built by Westinghouse in 1944.

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Faraday Unit Moves

The Stanley & Patterson Division of the Faraday Electric Corp. has moved to 434 Newbury St., Boston 15, Mass. The machinery and personnel of the Holtzer-Cabot Signal Division as well as equipment and personnel from the Faraday plant at Adrian, Mich., will be combined at the new address. Paul E. Friewald is the sales manager of this division and George Rick is in charge of manufacturing.

A MODERN SYLLOGISM

MAJOR PREMISE:

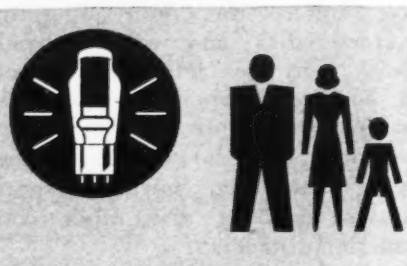
Bell Telephone System serves the American Public.

MINOR PREMISE:

Bell Telephone Laboratories develop the facilities of the Bell System.

CONCLUSION:

Therefore, Bell Laboratories serve the American Public.

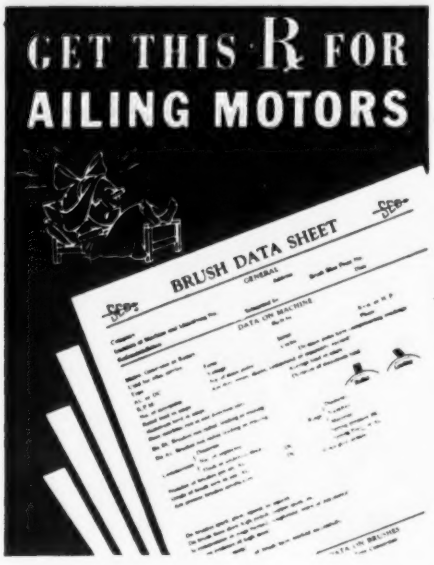


And that is the *raison d'être* of the Laboratories. For the Bell Telephone System, the Laboratories carry on research studies in all the sciences and development work in all the engineering arts that relate to electrical communication.

For the Western Electric Company, the manufacturing unit of the System, the Laboratories develop equipment, prepare specifications for its construction, and engage in various engineering activities.

For the Armed Forces of the United States, under contracts of the Western Electric, the Laboratories have undertaken more than a thousand development projects — many with spectacular effect upon our enemies.

BELL TELEPHONE LABORATORIES ***explore and invent, devise and perfect for our Armed Forces at war and for continued improvements and economies in telephone service.***



A good tonic for motors and plating generators that falter under strenuous service is, very often, a new set of brushes—not just any set—but brushes selected specifically for the job.

SPEER can help you speed your trouble shooting on ailing motors by the use of its Brush Data Forms . . . can prescribe the brush grade best suited for their operating characteristics and service conditions. Why not let SPEER apply its 45 years experience in brush making and application in finding the right cure for excessive brush wear, chattering, burning, sparking, overheating and other commutation ailments.

Chances are SPEER can improve the performance of motors, generators and converters for you as it has for many others. There's no charge or obligation. Here's all you need do to take advantage of this service: Send for SPEER Brush Data Forms for all machines whose performance you wish to improve. Fill in and return the forms to us: —back to you will come SPEER'S recommendations. Write today for your Brush Data Forms.

5734

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CARBON COMPANY
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CHICAGO · CLEVELAND · DETROIT
MILWAUKEE · NEW YORK · PITTSBURGH

Field Reports on Business

Plans for the modernization of lighting in industrial and commercial type buildings feature the electrical market. Government demands for electrical supplies to meet Navy requirements are urgent. Recent orders include switchboards, cable and conduit and radar and communications equipment. Retail trade continues active.

CHICAGO

While electrical manufacturers in this area continue to concentrate on production of standard line apparatus for government agencies, reports here indicate a growing volume of both inquiries and orders from utility sources. One large manufacturer of high-tension switchgear estimates there has been a 50 percent increase in inquiries and orders from utilities during January and February compared with the last quarter of 1944. If this increase holds it should carry utility bookings above any year since 1941 it was predicted. The rocket program and Pacific campaign are being reflected in increased orders for cable accessories.

Bidding was closed March 2 on the installation of a lighting system at the Rock County, Wisconsin, airport. The project calls for a 51-ft. beacon tower and beacon light, underground conduit system, flush marker lights, transformer house and control equipment.

War Department has recently authorized expansion of the Wabash Ordnance Plant for the production of smokeless powder. Project, amounting to $20,000, involves extension of the electrical distribution system, transformer stations and other electrical facilities.

Meanwhile in Detroit, WPB has announced that since January 1 nearly a billion dollars in new war contracts have been approved for placing in the 11th WPB region.

Although most other business indexes in the Chicago area climbed during January, building construction in 190 Illinois cities decreased 37 percent in number of projects and 50 percent in valuation, compared with December.

NEW ENGLAND

Plans for the modernization of lighting in industrial and commercial type buildings in the Greater Boston area are moving ahead at an accelerated pace and utility lighting division engineers report more than double the applications for engineering services since the beginning of the year as compared with 1944. Contracts granted by the DFC for purchase of additional equipment reported from this district include $2,000,000 for the Armstrong Rubber Co., West Haven, Conn., and a $50,000 grant to General Electric for additional facilities at its Bridgeport, Conn., plant. Recently 96 Silentvane type units manufactured by B. F. Sturtevant Co., Hyde Park, Mass., were installed by the Navy in overseas locations.

Street and building lighting plans are in the offing in Rhode Island where officials of the Rhode Island Public Works Department have requested emergency authorization of more than $10,000,000 to take care of repair and restoration to reasonable standards of streets, bridges and buildings under its domain.

Government demands for electric supplies for lighting and power lines in connection with the conversion of vessels for troop transport and hospital service are urgent. Bids on 430 portable surgical spotlights, 300 size "A" electrical distilling apparatus and 30 metabolism units show the pressing demands which manufacturers in this area are meeting as fast as possible. A large number of amplifiers was recently bought by the Navy for installations overseas and at naval bases. An adaptor order amounting to $47,000 was received by a Massachusetts company last week, and radar, submarine signalling apparatus and field communication sets are being supplied steadily.

NEW YORK

Following the recession of previous weeks brought about by unfavorable weather conditions and the ensuing difficulties in transportation, industrial output moved ahead slightly during the past week.

In the largest financing by the utility industry this year, $35,000,000 of Oklahoma Gas & Electric Co. first mortgage 2¾ percent bonds were put on the market last week. Among the new issues registered with the SEC are Laclede Gas Light Co. $19,000,000 of bonds and $3,000,000 of debentures and New York Power & Light Co. $50,000,000 of first mortgage bonds.

Civil engineering construction volume for the short week due to the early closing for the Washington's Birthday holiday totaled $16,301,000. This volume was 26 percent lower than in the corresponding 1944 week and compared with $43,908,000 reported to *Engineering News-Record* for the full preceding week. Private construction was 220 percent higher than in the 1944 week, but public construction was 65 percent lower than last year. The week's construction brought 1945 volume to $197,709,000 for the eight weeks, a decrease of 28 percent from the $274,396,000 reported in 1944.

Retail trade in the Metropolitan area continued active.

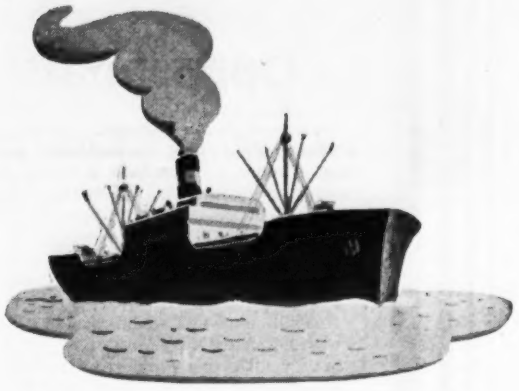
PACIFIC COAST

Housing allotments and subcontracts for new or reconditioned distribution systems in large government installations feature recent business.

Orders include switchboards, instruments, cable and conduit for Imperial Irrigation District; panels, controls, and accessories for Oakland's Bixler pumping plant, a blanket award for installing fire alarm systems in 65 government locations in southern California and Arizona; and considerable 1,500,000 cir. mil. varnished cambric cable for Bonneville system.

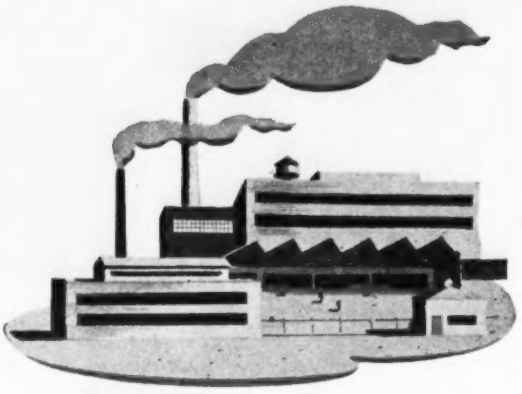
Radio developments cover proposed removal of Navy transmitting station from Mare Island to nearby Dixon at cost of $1,000,000; a new Navy radio station in North Bay area to cost $500,000; and San Francisco's application to WPB for a two-way radio station and headway control to speed its congested street railway traffic.

Major power projects cover the proposed Bridge Canyon Dam, 120 miles above Boulder to house its power plant inside the dam; and a counter-proposal submitted by various irrigation districts and other units in San Joaquin Valley to the government plans for the Pine Flat Dam and hydro system on Kings River. The new plan provides a nucleus of 115,000 hp. capacity to cost $19,000,000. The Navy is to install a $2,623,000 plant at Torrance for salvaging radio and electronic material damaged in the Pacific war area.



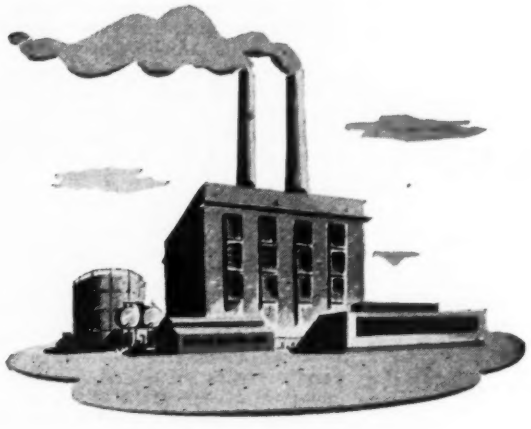
COOLER — CLEANER — LONGER LIFE

Early tube failure was traced to plug-type dezincification, with a change of metal indicated. But Scovill *Service in Metals* blamed unusually high temperatures and insufficient tube cleaning. Better operation lengthened life of replacement tubes many years.



LOCALIZED INFECTION CURED

Persistent failure of two rows of tubes in the first pass of a condenser was puzzling, because tubes in adjacent areas were normal. Scovill *Service in Men* helped the chief engineer work out an inexpensive construction change, ending the premature failure.



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Scovill's Condenser Tube Booklet will be found in many a utility power plant — on industrial and marine engineers' desks, too — because it gives valuable information on metals, installation, analyzing trouble sources. It is part of Scovill's *Service in Manuals.*

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Royal-ettes

#6 in a series of informative news letters from a producer of Power Switching Equipment.

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Royal played the field against connector and bus fitting competition. This resulted in what we believe to be a more comprehensive line of fittings than listed by any other manufacturer.

Did we get encouragement and suggestions from the field? Most certainly.

One outstanding idea came from C. D. (Jerry) Eash of Consumers Power Company. Here it is. "Incorporate in the design of the fittings a means to prevent turning of the bolt so that only one wrench is required to cinch up the nut."

Here is what we did about it! We changed our pattern equipment so that one of the body castings is provided with ears which nest the bolt head. See drawing page 4 of our Catalog No. 10. This design permits the use of standard hex head machine bolts. Special bolts only complicate the situation.

When a fellow is sitting in a bos'n's chair high up in a substation structure, installing tubular bus, he can make good use of the hand made free for him by these Royal "one-wrench" fittings.

NESTED BOLT HEADS

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Sales Opportunities

OREGON—California-Oregon Power Co., Medford, plans new hydroelectric power plant. Project will include a power dam about 35 ft. high, with 7,600-ft. tunnel leading to mouth of creek for stream diversion, providing head of approximately 415 ft. at station site. Plant will be equipped with hydraulic-turbine units of gross rating of about 53,600 hp. A switchyard will be constructed and new transmission to connect with company high-tension system, approximately 40 miles long. Entire development is estimated to cost about $4,000,000. Application for permission has been made to Federal Power Commission and Oregon State Hydroelectric Commission, with final surveys and plans to proceed as soon as authority is granted.

OHIO—War Department, Washington, D. C., has authorized expansion in plant, comprising several buildings with machinery and electrical equipment for manufacture of tire rims for heavy-duty service for army trucks and vehicles. Cost about $1,150,000. Work will be placed under way soon and will be supervised by U. S. District Engineer Office, Pittsburgh, Pa.

TEXAS—Central Power & Light Co., Corpus Christi, has plans maturing for new 60,000-volt transmission line, close to 100 miles. It is understood that project will have a priority rating, with work scheduled to begin at early date.

MINNESOTA—Interstate Power Co., Dubuque, Iowa, has begun construction of new double-pole transmission line. Right-of-way has been acquired along East boundary line of Waseca County. A power substation is planned and a single-pole line will be constructed to point where terminal substation will be located. Entire project is estimated to cost about $500,000 and will require several months for completion.

INDIANA—Stauffer Chemical Co., Hammond, will carry out expansion in local plant for increased production of sulfuric acid for government, including several buildings with machinery and electrical equipment for heavy output. Cost estimated about $700,000, with financing by Defense Plant Corporation. Work will be placed under way soon. Main offices of company are at 420 Lexington Ave., New York, N. Y.

TEXAS—U. S. Engineer Office, Fort Sam Houston, San Antonio, has plans nearing completion for electrification of ranges at Army airfield, including extensions in present distribution system, with service connections and other facilities. Also, extensions in power substation, with installation of transformers, switchgear and accessories. Bids are scheduled to be asked soon.

WASHINGTON—Department of Lighting, Seattle, has plans under way for extensions and improvements in sub-transmission lines and power substation facilities in different parts of city during present year, including underground duct additions, service connections, etc. Considerable new equipment will be purchased, including cable and line materials, switchgear, transformers for new bank of about 10,000-kw. rating, and several complete prefabricated unit type substations. Entire project is estimated to cost approximately $1,250,000.

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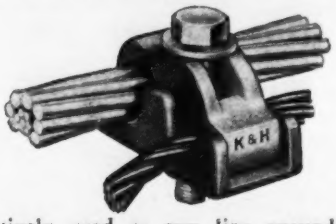

Effectively used as guy line ground, or transformer and lightning arrester connection to A. C. S. R. or copperweld conductors where the diameters may be from 8-A copperweld to .595" A. C. S. R. armour rods. Wire sizes .595" to 5/32".

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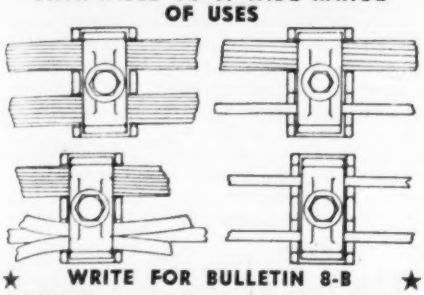

★ WRITE FOR BULLETIN 8-B ★

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PENNSYLVANIA—War Department, Washington, D. C., has authorized conversion of warehouse property for new plant, to be known as Washington Forging Plant, designed for steel shell production. Work will include additional buildings, with machinery and electrical equipment for large output. Several electric furnaces, with controls and accessory equipment are planned. Entire project is estimated to cost $725,000, and will be supervised by U. S. District Engineer Office, Baltimore, Md. Work will be placed under way soon.

CALIFORNIA—Water Department, Newport Beach, plans new pumping station in connection with extensions in municipal water system as a post-war project. Installation will include motor-driven pumping units, controls and auxiliary equipment. Entire program is reported to cost about $120,000. Richard L. Patterson is city engineer.

NEW MEXICO—Albuquerque Gas & Electric Co., Albuquerque, plans extension in steam division at local steam-electric generating station, including installation of new high-pressure boiler and accessory equipment. It is understood that project will have a priority rating. Cost estimated close to $200,000.

CALIFORNIA—City Council, San Diego, has authorized installation of new street lighting units at a number of highway intersections. Work is scheduled to be carried out soon.

INDIANA—War Department, Washington, D. C., has approved plans for expansion in ammunition loading facilities at Hoosier Ordnance Plant, including number of new buildings, with machinery and electrical equipment for considerable increase capacity. Cost estimated about $1,400,000. Work will be placed under way at early date and will be supervised by U. S. District Engineer Office, Louisville, Ky.

FLORIDA—Light and Water Department, Lake Worth, has plans under way for extensions in municipal power plant, including installation of new diesel engine-generator units and auxiliary equipment, estimated to cost close to $450,000. Project will include extensions in transmission and distributing lines, as well as a new water-softening plant for municipal water system; last noted will cost approximately $150,000, in addition to sum mentioned. Proposed to ask bids early in spring. Burns & McDonnell Engineering Co., 107 West Linwood Blvd., Kansas City, Mo., is consulting engineer.

ARKANSAS—American Can Co., Inc., 230 Park Ave., New York, N. Y., has contracted with government for construction and operation of new plant for manufacture of solid fiber containers for packing and shipping of ammunition. Local industrial building, totaling close to 275,000 sq. ft. floor space, on 11-acre tract of land, has been acquired for initial plant unit, and will be modernized and improved at once, with installation of machinery and electrical equipment for large output. Additional buildings will be erected on adjoining site. A power substation is planned. Entire project will cost about $3,500,000. It is understood that financing will be by Defense Plant Corporation. Company has organized an affiliated interest under name of American Containers Corp., to carry out program.

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Recent Legislation

ARIZONA—A bill has been introduced in the Senate, exempting from legislative approval power authority filings for water. An identical bill has been introduced in the House. Another measure introduced in the Senate would appropriate $50,000 to the corporation commission to pay expenses of Federal Power Commission survey of Arizona utility valuations and rates. An identical bill has also been introduced in the House.

INDIANA—Measure has been introduced in the House which would create a state board of electrical administration to be named by the Governor with power to adopt standards for licensing of electrical contractors and electricians.

MAINE—Under the terms of a bill introduced in the Legislature a Passamaquoddy District Authority would be created to build and operate power plants at Eastport in the far-eastern tip of Maine. The legislation to authorize the development of the suspended Federal tide-harnessing power project was asked by Rep. Thomas A. Gallant (Republican) of Eastport. The Authority, comprised of a board of seven directors, named by the Governor with approval of his Executive Council, would be authorized to acquire and operate property "customarily employed in the manufacture, production and generation of power" and could "transmit, distribute and sell" water, steam and electric, hydro-electric and tidal electrical power." Since the shut-down of the Federal project, the buildings at Eastport have been used by the National Youth Administration and for training of Seabees. Borrowing rights and powers of eminent domain would be given the authority under terms of the measure and it could contract with public or private electric power companies for mutual exchange of unused excess power. It could not, however, distribute or sell electric power or water for other than industrial uses or consumption in any community within the area supplied by an existing electric or water company without approval of the state Public Utilities Commission. Exemption from taxes would be given the authority though it might agree to pay a county or municipality for improvements, services, and facilities furnished by the Authority. It would have the power to take, divert, use and distribute from any lake or stream within the district which would include 21 Washington County cities and towns.

MARYLAND—A bill requiring the state Public Service Commission approval for any overhead power line carrying more than 15,000 volts has been introduced in the Legislature—the latest move in a two-year dispute between the Consolidate Gas Electric Light & Power Co. and property owners in the Falls Road area in Baltimore County. The utility has projected such a line for erection on or near several county estates and the Five Farms golf course if and when it can get the approval for the materials from the WPB. Meanwhile the property owners have been fighting to make the line take a different course or go underground.

NEW YORK—A bill has been introduced in the Senate by Senator John V. Downey, which amends the Transportation Corporation Law relative to electric and gas service. The bill has been referred to the Corporation Committee. The amendment provides that the supply of electricity or gas shall not be discontinued for any cause instead of for non-payment of bill, until and after a five-day written notice has been given either personally or by registered mail. Senator Arthur H. Wicks, Republican of Kingston, N. Y., has introduced a

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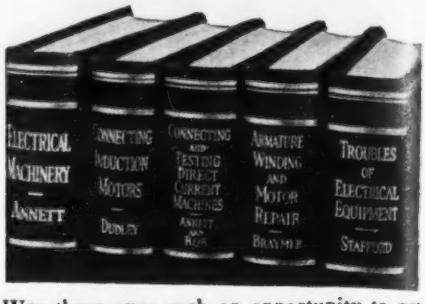

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Electrical Maintenance and Repair Library

5 volumes, 2042 pages, 1721 illustrations

Gives you the "know-how" to tackle any wiring or motor job. Five books show you HOW—to install all types of motor and generator units—to inspect and repair motor starters and generators—to diagnose motor and generator troubles—to figure new windings for old cores, DC and AC windings—to test armature windings, test induction motors, etc., etc. The new book is full of trouble-shooting charts that show quickly symptoms, causes, specific remedies, etc.

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bill which amends section 20-b of the General City Law, continuing to July 1, 1946, provision authorizing cities to impose tax of not to exceed one percent on gross income or gross operating income of corporations and persons furnishing utility services.

SOUTH CAROLINA—Senate has received from the House a concurrent resolution directing the state Public Service Commission to set "at cost" electric rates for rural electric cooperatives. Representative R. M. Kennedy of Kershaw has announced that he would offer an amendment to his bill to reduce salaries of the power authority and prohibit legislators from being authority employees. Thus the Santee-Cooper hydroelectric project would be brought directly under legislative control. Representative Kershaw's amendment also would put the authority under the regulatory provisions of the state Public Service Authority "as are other electric utilities." It was pointed out that the Santee-Cooper annual budget would have to be submitted to the state budget commission and an itemized appropriation would have to be made by the legislature for administration of the power project. Representative Kennedy's bill, currently on the House calendar with a majority unfavorable House judiciary committee report, would set a $6,000 ceiling on Santee-Cooper salaries. Kennedy's bill also makes legislators ineligible for employment by the Santee-Cooper project.

•

Recent Rate Changes

ILLINOIS POWER CO. has been ordered by the state Commerce Commission to reduce rates for residential and commercial electric service in Abingdon, Monticello, Georgetown, Chester, Pinckneyville, Sparta and Westville $162,970.

ALABAMA POWER CO. according to the state Public Service Commission, has reduced its wholesale electric rate contracts to ten Alabama rural electrification projects (REA) from 14 to 20 percent.

WISCONSIN MICHIGAN POWER CO. has reduced its rate to 3,287 commercial customers by $13,200 annually, the state Public Service Commission has announced. W. E. Schubert, vice-president and general manager of the company, said the order affects both the metropolitan and the outlying areas of the company's territory.

•

New Television Series Opened by Kelvinator

The first commercial television program featuring Kelvinator electric ranges and refrigerators was presented recently by the Kelvinator division of Nash-Kelvinator Corp. in opening its new television series, "Society of Amateur Chefs—Fun in the Kitchen," a 30-minute comedy program on WADB (Dumont).

"In line with Kelvinator's policy of investigating new advertising media to maintain merchandising leadership in the kitchen appliance industry, we recognize that television is destined to become a major advertising factor in the coming years, and we intend to be prepared to utilize its selling advantages to the fullest," Charles J. Coward, Kelvinator's director of advertising, said.

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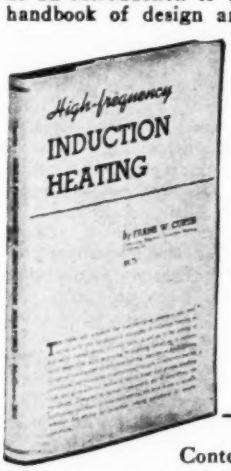

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By FRANK W. CURTIS,
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235 pages, 5¼ x 8¼, 249 illustrations, $2.75

Written by a specialist in the field, this book gives a clear and thorough understanding of the practical techniques of this *stream-lined* method of heating metals . . . explains the fundamental electrical principles involved . . . defines its range and scope . . . describes construction design of induction-heating coils . . . discusses in detail many applications of induction heating to specific heating problems . . . and discusses the marked effect the technique will have on manufacturing methods and future constructional design.

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3. Design of Induction-Heating Coils
4. Brazing, Soldering, and Joining
5. Hardening and Heat-treating
6. Fixtures for Induction Heating
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REA Allots Funds; Approves Contracts

The Rural Electrification Administration has recently approved loan allotments totaling $681,000 to ten rural cooperatives in nine states. These funds, which will be used mainly for the extension of electric service to farms located near existing lines, bring total REA allotments to $521,250,801, of which $22,371,000 represents current fiscal year operations.

Unless otherwise noted, the loans listed below will provide for service extensions:

DELAWARE—Delaware Rural Electric Assn., Greenwood, $15,000.

ILLINOIS—Illinois Rural Electric Co., Winchester, $85,000 for service extensions and installation of circuit breakers.

MINNESOTA—Steele Waseca Cooperative Electric, Owatonna, $35,000; Crow Wing Cooperative Power & Light Co., Brainerd, $25,000.

MISSOURI—Platte-Clay Electric Cooperative, Inc., Platte City, $25,000.

NEBRASKA—Butler County Rural Public Power District, David City, $15,000.

NEW MEXICO—Farmers' Electric Cooperative, Inc., Clovis, $55,000.

NORTH CAROLINA—French Broad Electric Membership Corp., Marshall, $196,000, for rehabilitation and improvement of electric facilities, including improvements to generating plants.

SOUTH DAKOTA—Lake Region Electric Assn., Inc., Webster, $160,000.

UTAH—Garkane Power Assn., Inc., Richfield, $70,000.

Construction Contracts Approved

ARKANSAS—Riceland Electric Cooperative, Inc., Stuttgart, to Harvill-Byrd Electric Co., Little Rock, Ark., 57.4 miles of line; all materials, except poles, and labor, $47,753.

MISSOURI—Nodaway-Worth Electric Cooperative, Inc., Maryville, to A. A. Electric Co., Cicero, Ill., 102.8 miles of line; labor and materials, $99,627.

TEXAS—Hill County Electric Cooperative, Inc., Itasca, to White & White Construction Co., Electra, Texas, 25 miles of line; labor only, $5,929. South Plains Electric Cooperative, Inc., Lubbock, to Taylor & Montgomery, Lubbock, Texas, 28.5 miles of line; labor only, $6,959. Lamb County Electric Cooperative, Inc., Littlefield, to Taylor & Montgomery, Lubbock, Texas, 100 miles of line; labor and materials, $76,873. Johnson County Electric Cooperative Assn., Clebourne, to State Electric Co., Fort Worth, Texas, 25 miles of line; labor only, $7,071. Victoria County Electric Cooperative Co., Victoria, to State Electric Co., Fort Worth, Texas, 100 Miles of line; labor only, $24,097. Southwest Texas Electric Cooperative, Inc., Eldorado, 202 miles of line; labor and materials, $136,826.

•

Ohio Brass Net Up

Ohio Brass Co. for the year 1944 reports net income totaling $631,004, or $1.81 a common share. For 1943 the net income amounted to $577,889, or $1.66 a share.

How to draw clear, accurate circuit diagrams and wiring plans

This book gives you tested drafting techniques needed in engineering and contracting, as applied to electrical circuits and wiring plans. In a progressive series of drawing plates and explanatory discussions, the book shows how to develop detailed wiring plans from the schematic circuit diagram, how to correlate the equipment-location plan, and how to check the design and execution of the finished drawing.

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By D. WALTER VAN GIESON

Assistant Electrical Engineer, Board of Transportation, City of New York

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In this unique presentation, the author describes and explains drawings taken from actual working installations to show typical applications in such fields as lighting, railway signals, communication, radio and television, and power—and including as well car, aircraft, and ship wiring plans, traffic signals, animated signs, and neon and fluorescent lighting. Besides treating the procedure for developing detailed wiring plans, the book explains the correlation of equipment-location and conduit-location plans, and discusses in detail how to check the finished drawing for proper design and correct execution.

The book gives you—

—valuable material on the principles of electricity and electronics

—useful data, specifications, and rates

—six pages of electrical symbols used in drafting circuits and wiring

—helpful tips on some of the "kinks" and shortcuts in drafting room procedure

—practice problems and test questions

Special attention has been given to recent advances in electrical drafting. Modern methods and symbols are introduced early in the book and are adhered to throughout. Points out small but important "tricks of the trade" that you might otherwise overlook, or have to learn yourself, the hard way.

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Expands Repair Services to Meet Navy Demands

To repair and maintain G.E. motors, generators and turbines of the expanding Pacific fleet of warships and cargo vessles, General Electric Co. is enlarging its present San Francisco service shop facilities by 35,000 sq. ft. of floor space and is preparing to service the largest equipment which can be trucked to the quarters. Previously, generators and steam turbines up to 2,000 kw. were handled.

Permanent alterations and installations of electric overhead cranes and machine tools, indicating continued industrial growth in the West, are underway and will nearly double the shops' previous capacity. Expansion is being carried out at the suggestion of and in full compliance with officials of the Twelfth Naval District, including offices of materiel procurement and the industrial manager at Mare Island. G.E. equipment of all marine operators is also serviced at the shop.

Final installation of equipment is expected to be completed early next spring, although repair work with new facilities to put damaged apparatus back in operation as quickly as possible is now underway.

•

New Condenser Mounting Withstands Vibration

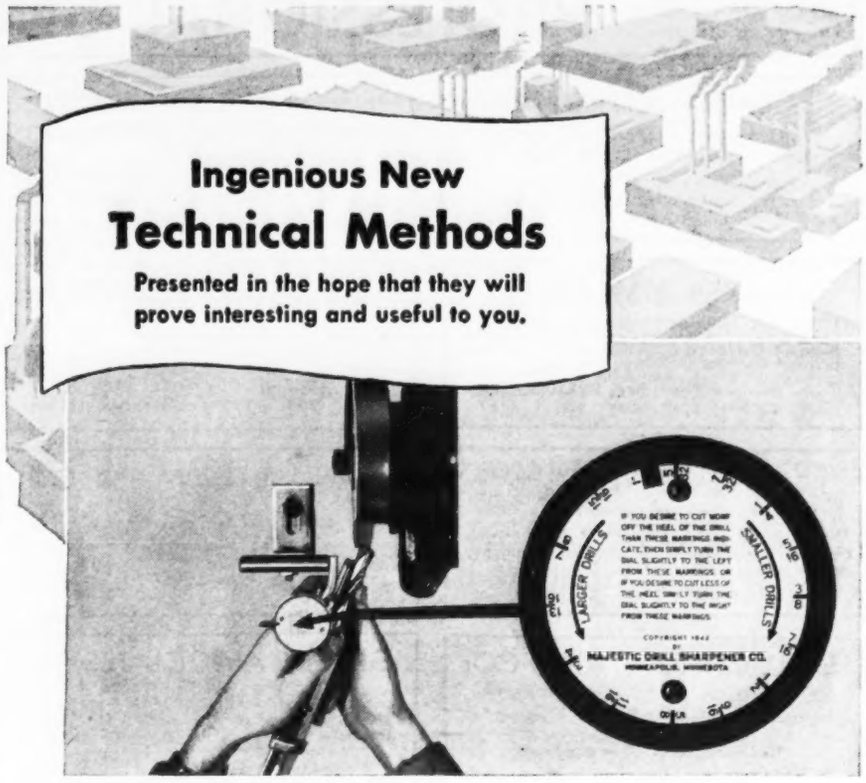
Industrial Condenser Corp. has announced a new M type bracket specially developed to withstand the most severe vibration conditions encountered by all branches of the armed forces. They meet all Army, Navy and aircraft specifications. Designed to permit the mounting of oil capacitors in either vertical or inverted position, they are readily adapted to any industrial application.

The company has recently moved into a larger plant at 3243-65 North California Avenue, Chicago.

•

War Betters Oscillograph

What happens to a laboratory instrument when it goes to war is told in design changes and refinements effected during the past two years and currently incorporated in Du Mont Type 208B oscillograph now offered by Allen B. Du Mont Laboratories, Inc., Passaic, N. J. Several wartime touches and several refinements such as the addition of mounting straps on capacitors subject to breakage in transit and tube clamps for tubes subject to jars have added to the ruggedness and dependability of this instrument.

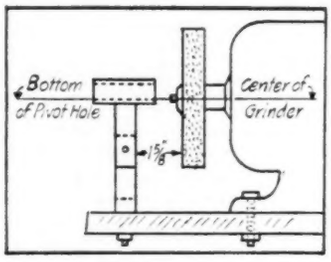


New Quick-set Dial Drill Sharpener Eliminates Guesswork . . . Keeps 'em Drilling Faster—Longer

Attached to the Drill Sharpener, it adjusts drill edges to the proper angle for precision grinding, putting drill sharpening on a quick, efficient basis.

QUICK-SET DIAL easily and accurately adjusts Sharpener for sharpening drill from 5/32" to 1" sizes. Dial insures accuracy in measuring angles and clearances on twist drills, preventing trouble and making drills last longer. Dial-Set sharpened drills cut faster and more accurately, as the edges are alike and uniformly sharpened.

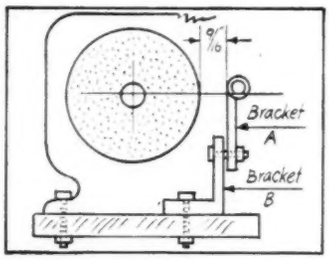
Precision built, calibrated and tested, unit is easy to set up and operate. Saves wear and tear on drill presses—prolongs drill life—cuts costs—improves quality—speeds output.



Front view of grinder

•

Another thing worth remembering is Wrigley's Spearmint Gum. That familiar red, white and green package which always meant "a help on your job." No more of this famous brand and flavor is being made for anyone now—even for the Armed Forces overseas—as Wrigley's stockpile of finest quality raw materials is all used up. But—remember Wrigley's Spearmint—The Flavor Lasts.



Side view of grinder

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LETTER TO THE EDITOR

Ideal Concept of Voltage Regulation

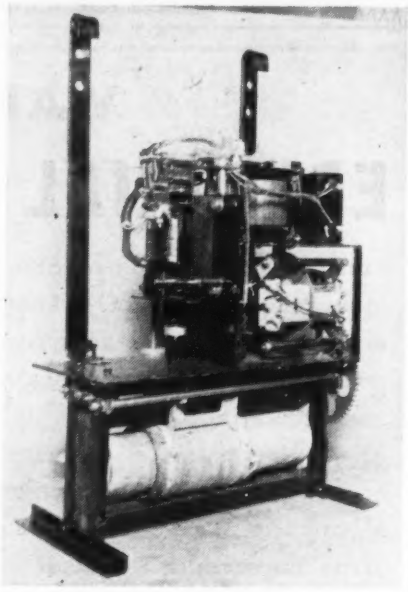
To the Editor of ELECTRICAL WORLD:

I was particularly interested to read the editorial under the above title in your issue of November 11th which has just reached us.

I wrote an article in "The Electrician" (a journal published in this country) for February 12, 1943, on the possibilities envisaged in your editorial. You will see that the following extracts from this article parallel very closely the corresponding parts of your editorial:—

"The need for constant voltage is of minor importance until the actual consumer is reached and, even then, is variable in degree depending upon the type of load. The ideal method of voltage control would, therefore, be the installation of an automatic voltage regulator at each consumer terminal or small group of consumers; this method would have numerous advantages, apart from solving the regulation problem. Transmission and distribution systems would be relatively free from restrictions due to voltage drop, and could be better planned with regard to continuity of supply (i.e., duplication of feeding points) and the thermal loading capacity of lines, cables and transformers. The higher permissible impedance would decrease short-circuit currents, and thence the resulting mechanical and thermal stresses, and permit the use of a cheaper design of switchgear of lower rupturing capacity. The consequent reduction in the cost of supply may be judged from the fact that at present the size (i.e., copper section) and cost of cables and lines (the principal items in distribution costs) are determined by voltage drop considerations. In fact, many thousands of tons of copper put into lines and cables in this country for voltage regulation purposes could be saved in future if local voltage control were adopted.

"The new principle, however, envisages a general change in policy from endeavouring to maintain constant potential throughout the system to allowing relaxation in the transmission and distribution circuits, with the advantages just described, and applying local control by means of automatic voltage regulators at, or near, the consumer's terminals, where the constant voltage is essentially required. The degree of de-centralization will depend upon local conditions; it is in fact possible in many cases to discriminate between different types of load, and thus confine the cost of close voltage control directly to particular loads where it is essential, instead of incurring the same costs for the whole of the load on the network."



AUTOMATIC MOVING-COIL voltage regulator giving 14 percent voltage in 15 kva., 110 or 230-volt single-phase circuit

The moving coil voltage regulator was described in an article in the ELECTRICAL WORLD for August 18, 1934, and the subsequently developed astatic voltage relay in the issue for March 13, 1937. The simplicity of this assembly made it peculiarly suitable and economical for small ratings and I believe meets the conditions stated in your editorial. We have been developing this application for some time and some thousands of small voltage regulators are now in service for localized automatic control.

In general the whole of the apparatus is contained in one tank and is oil immersed so that no lubrication or periodic attention is necessary. I believe that an automatic regulator with the whole of the operating mechanism including the voltage relay itself, oil immersed, is unique.

E. T. Norris, Chief Engineer
Transformer Dept.
Ferranti, Ltd.
Hollinwood, England

Be with your boys over there by giving over here to your Red Cross.

SEARCHLIGHT SECTION

(CLASSIFIED ADVERTISING)

Continued on page 164

POSITIONS VACANT

PRODUCTION ENGINEER — fractional h.p. electric motors. Should have specialty background in single phase motors, having devoted major effort to efficient mass production. Line will have limited size range. Engineering design experience desirable for development of motors for tooling and production. Permanent connection with outstanding Southern California manufacturer entering household appliance field. Send detail of experience and personal qualifications to A.W.A., Box 68, Station K, Los Angeles, California.

WATCH ENGINEER for outstanding municipally owned electric generating plant. Required preparation: High School graduate supplemented by study along mechanical engineering lines—preferably with at least one or two years college work and at least five years experience in a power plant. Must be free of draft. In reply, please state age, education, experience, draft status and general qualifications. P-818, Electrical World, 520 N. Michigan Ave., Chicago 11, Ill.

MECHANICAL, ELECTRICAL, and structural designer-draftsmen familiar with steam power plants. Also several men for appraisal work. Location: Boston, Mass. Furnish complete experience record, including present and expected salary. Statement of availability required. Write to P-829, Electrical World, 330 W. 42nd St., New York 18, N. Y.

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SALARIED POSITIONS — This advertising service of 35 years recognized standing negotiates for high salaried supervisory technical and executive positions. Procedure will be individualized to your personal requirements and will not conflict with Manpower Commission's. Retaining fee protected by refund provision. Identity covered and present position protected. Send for details. R. W. Bixby, Inc., 262 Delward Bldg., Buffalo 2, N. Y.

POSITIONS WANTED

MAN WITH years of varied utility experience and electrical engineering background desires employment. PW-810, Electrical World, 330 W. 42nd St., New York 18, N. Y.

EXECUTIVE ASSISTANT or territory manager; 23 years field experience in utility business, 7 in accounting and 16 as territory operating manager. Experience also included Municipal franchise and contract negotiation and public relations work. Age 46, married, good health, references. Available on reasonable notice. Middle West preferred. PW-821, Electrical World, 520 N. Michigan Ave., Chicago 11, Ill.

DESIRE Connection with electric utility, 11 years experience supervision transformer repairs substation maintenance and construction and other utility work. Past draft age. Interested in anything permanent only. Married, one child. PW-823, Electrical World, 520 N. Michigan Ave., Chicago 11, Ill.

ELECTRICAL ENGINEER, University graduate, 22 years varied experience, 10 years electrical maintenance engineer in large industrial plant. Would like similar position in an essential but permanent industry. Age 45, married, excellent references. Prefer to locate in southern states. PW-830, Electrical World, 520 N. Michigan Ave., Chicago 11, Ill.

Continued on page 164)

Illumination Engineers

Design Engineer **on Aviation, Marine and Floodlighting equipment—must be able to prepare specifications for manufacture and test of such equipment, also redesign of present equipment. Salary $215 to $300.**

Application Engineer **to analyze proposed illumination projects—must have electrical engineering background and experience on lighting problems. Will be expected to render engineering assistance on negotiations. Salary $215 to $300.**

Write Supervisor of Technical Employment for application, 306 Fourth Avenue, Pittsburgh, Pennsylvania.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY

(Continued from preceding page)

SALESMAN WANTED

LIGHTING SALES ENGINEER—Electric Utility company located in the midwest has opening for several lighting sales engineers, either experienced or beginner grade. Straight salary basis, commensurate with qualifications. Address applications to SW-831, Electrical World, 520 N. Michigan Ave., Chicago 11, Ill.

SALESMAN AVAILABLE

ELECTRICAL ENGINEER, 28, graduate, family, electronics training. Experience includes electrical construction, inspection, and design. Desires position as sales and application engineer offering more opportunity to apply electronics training, engineering aptitude, and sales personality. Essential work in electronic control or high frequency heating preferred. Minimum salary $5,000. West or Northwest desired. SA-832, Electrical World, 520 N. Michigan Ave., Chicago 11, Ill.

REPRESENTATIVE AVAILABLE

PACIFIC COAST representation. A firm consisting of three partners who possess extensive business and merchandising experience on the Pacific Coast, particularly in the San Francisco area, is desirous of contacting manufacturers who contemplate renewing or establishing agencies on the Pacific Coast. Satisfactory references can be furnished. Write King, Shea & Poston, 604 Mission St., San Francisco 5, Calif.

WANTED

ANYTHING within reason that is wanted in the industry served by Electrical World can be quickly located through bringing it to the attention of thousands of men whose interest is assuured because this is the business paper they read.

WANTED
LIGHTING SPECIALIST

We have a desirable opening for a man with vision and ability to create special lighting ideas beyond the range of ordinary lighting fixture installations.

Will advise customers and prospective customers of the Sales Dept. in special lighting applications of Department Stores, Chain Stores, etc.

College training preferred; should have a background in illuminating engineering or be a lighting specialist with a utility or be a designer of special fixtures.

Early New York or Boston interview will be arranged for qualified applicants furnishing full details as to age, education, experience and salary requirements.

P-815, Electrical World
330 W. 42nd St., New York 18, N. Y.

WANTED
MECHANICAL ENGINEER

Capable of taking complete charge of the Design of Steam Power Plant work in an Engineering Office. College graduate. 30 to 40 years old. Location Boston. Statement of Availability Required. Address

P-833, Electrical World
330 W. 42nd St., New York 18, N. Y.

WANTED
DESIGNER

A Central New England manufacturer employing over 1000 people needs Draftsman-Designer on telephone and signaling (mechanical) apparatus.

Knowledge of die-casting and plastic applications desirable.

WMC Regulations Prevail

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(Classified Advertising)

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Excellent position is available for technical editor and writer. Man must have thorough knowledge of principles of electrical engineering. Should have facility as a writer and be able to review and to analyze critically the writings of others on engineering subjects. This is a permanent position and offers excellent opportunity to a man with imagination, good engineering background, and writing ability. Starting salary $3600. for applicant who in our judgment fully meets our requirements. Write Supervisor, Technical Employment, 306 Fourth Avenue, Pittsburgh, Pennsylvania.

WESTINGHOUSE ELECTRIC & MANUFACTURING CO.

WANTED
DEVELOPMENT ENGINEERS

Mechanical and electrical. Graduate or equivalent training. Required for development work in the following branches:

1. Electro-mechanical devices, communication systems. Must be interested in development and familiar with magnetic circuits.
2. Measuring and control instruments. Background should be in electrical engineering, including electronics.

Statement of Availability Required.

P-825, Electrical World
330 West 42nd St., New York 18, N. Y.

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EQUIPMENT WANTED

WANTED TO BUY

A modern used Diesel generating set in good operating condition with the following characteristics—

Make	Preferably Fairbanks Morse Type VA
Size	300 KVA to 500 KVA
Speed	240 rpm to 360 rpm
Generator	2300 volt, 3 phase, 60 cycle with exciter
Switchboard ..	O.I circuit breaker with usual essential instruments. No muffler required.

Must be equipped with complete air starting equipment and air tanks, also fuel tank of at least 1000 gallons capacity.

Must be located East of the Mississippi and subject to our inspection.

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3 PHASE 60 CYCLE
1—500 HP, 900 RPM, 440 volt, Lincoln slip ring
1—350 HP, 300 RPM, 440 volt, G.E. slip ring
1—225 HP, 1800 RPM, 220 volt, G.E. slip ring
1—200 HP, 600 RPM, 440 volt, Crocker Wheeler slip ring
1—200 HP, 600 RPM, 2200 volt G.E., sl. rg.
1—200 HP, 450 RPM, 2200/4000 v. G.E. sl. rg.
1—150 HP, 1800 RPM, 440 volts, G.E. sq. cg.
2—150 HP, 1200 RPM, Westinghouse, squirrel cage
2—150 HP, 1800 RPM, 220 volt, Westinghouse slip ring
1—100 H.P. 1800 R.P.M. 440 volt, General Electric, squirrel cage
1—60 H.P. 1200 R.P.M. 2200 volt, General Electric, slip-ring

D. C. 230 VOLTS
2—450 HP, 400 RPM, General Electric MPL.
1—250 HP, 760 RPM, Electro Dynamic.
1—150 HP, 750 RPM, Electro Dynamic.
1—150 HP, 500 RPM, General Electric, MPC.
1—125 HP, 600 RPM, Westinghouse, SK.
1—100 HP, 625 RPM, G.E.
1— 80 HP, Crocker-Wheeler, 600 RPM.
1— 75 HP, 575 RPM, General Electric
3— 50 HP, 700 RPM, Crocker-Wheeler

VARIABLE SPEED 230 VOLTS
1—90 HP, 470/940 RPM, General Electric.
1—75 HP, 525/1575 RPM, Electric Dynamic.
1—60 HP, 500/1000 RPM, Diehl.
1—30 HP, 225/900 RPM, Crocker-Wheeler.
1—30 HP, 400/1200 RPM, General Electric.
2—25 HP, 650/2200 RPM, Westinghouse.
2—25 HP, 300/900 RPM, Electro Dynamic.
1—15 HP, 300/1200 RPM, General Electric.
1—13/18 HP, 350/1200 RPM, Electro Dynamic.
1—10 HP, 400/1600 RPM, Westinghouse, SK.
1— 5 HP, 450/1800 RPM, Crocker-Wheeler.

MOTOR GENERATOR SETS
1—750 KW, 250 volt, Allis-Chalmers, Synchronous.
1— 75 KW, 125 volt, General-Electric, squirrel cage.

TRANSFORMERS
2—400 KVA, G.E. 4156-240/480 v. Scott taps.
3—300 KVA, Pittsburgh 7800/440 volt.
3—150 KVA, G.E., 33,000 2300/4000 Y.
3—100 KVA, Westinghouse, 11,430/250 volts.
1—100 KVA, Pittsburgh, 1375/2750-110/220 volts.
3—100 KVA, Westinghouse, 13200 250 volts.
2—100 KVA, G.E. 2200/220/440.
2— 75 KVA, General Electric 3 phase, 4150 Y, 120/208Y.
3— 50 KVA, Pittsburgh 2200/220/110.

ALTERNATORS
1—625 KVA, 3600 RPM, 600 volt, G.E.
1—225 KVA, 514 RPM, 600 volt, Westinghouse.
1—200 KVA, 3600 RPM, 250 volt, Allis-Chalmers.
1—62½ KVA, 3600 RPM, 220 volt, Allis-Chalmers.

TURBO GENERATORS
600 KW, Terry dual bleeder condensing Turbine only
1—500 KW, G.E., 3 ph., 60 cy., 480 volt, bleeder.
1—375 KVA, Westinghouse, non-condensing.
1—300 KW, G.E., 3 ph., 60 cy., 220 volt, cond.
1—200 KW, G.E., 3 ph., 60 cy., 220 volt, cond.
1—30 KW, 125 volt, Allis Chalmers.

ENGINE GENERATOR SETS
1—150 KVA, General Electric Generator, Ames Uniflow engine.
1—62½ KVA, Westinghouse Generator, Fairbanks company engine.

Complete Line of A.C. and D.C. Motors and Generators

FOR SALE
DYNAMOMETERS

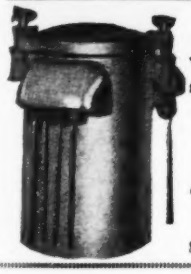
1—200 HP G.E., Sprague, type C, dynamometer, laboratory test type, 250 volts, shunt, interpole, 1200/1500 RPM, with Scale beam and complete control panel.

1—50 HP G.E. Sprague, block test, 275 volts, 750 to 2000 RPM, with complete control panel.

9—25 HP G.E. Sprague, type LC, shunt, interpole, block test, 250 volts, 825/2000 RPM, with complete control panel.

CHICAGO ELECTRIC CO.
1314 W. Cermak Road
Chicago, 8, Illinois

-TRANSFORMERS-



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One Year Guarantee

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"AMERICA'S USED TRANSFORMER CLEARING HOUSE"
STATION M Since 1912 CINCINNATI 27, OHIO

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8-Ton Whitcomb gasoline 36" gauge.
15-Ton Porter saddle tank 36" gauge.
20-Ton Whitcomb Diesel 36" gauge.
21-Ton Porter saddle tank 36" gauge.
30-Ton Vulcan saddle tank 56½" gauge.
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22½-Ton McMyler-Interstate. Steam.
25-Ton Browning. Steam.
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GASOLINE CRANES
1—Browning "E" on AC Mack truck.
1—P & H 600, 60 ft. boom shovel front and dragline.

GASOLINE TRACTORS
2—Allis-Chalmers Model K (one with blade; one without).
1—Caterpillar Model D-35, with blade.
1—T20 International Bulldozer.

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Telephone PEnnsylvania 6-3175

Offered Subject to Prior Sale

300 H.P. McIntosh-Seymour Diesel Electric Generating unit, 3 Cyl., 4 Cycle air injection Direct Connected to G.E. Type TRE, Form D.S. Generator, 2300 volts, 3 phase, 60 cycle, also direct connected exciter. Immediately available in Central Kansas.

165 H.P. Busch Sulzer Diesel Electric Generating Unit, 4 Cyl., 4 Cycle air injection Direct connected to G.E. Type TRE generator, 3 phase, 60 cycle, 2300 volts. Shaft extension for exciter, but no exciter. Immediately available in Southwestern Kansas.

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Service backed by 40 years' experience

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NO PRIORITY NEEDED

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500 10 ampere 2 wire 120 volt A.C. Westinghouse O.B. meters, used excellent condition, each meter separately boxed.

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Rotary Converters—3 Ph. 60 Cy.

K.W.	Make	R.P.M.	D.C. Volts	A.C. Volts
1—1500	Whse.	720	650	11500
1—1250	G.E.	720	250	2300
1—1000	Whse.	900	600	2300
2— 750	Whse	1200	600	2300/4000
1— 500	G.E.	1200	600	13200/2300

Rotary Converters—3 Ph. 25 Cy.

2—1500	G.E.	500	225/275	6600
1— 500	G.E.	750	225/275	6600

M. G. Sets—3 Ph. 60 Cy.

1—1500	G.E.	360	250	2300/4600
1—1000	G.E.	720	250	2300/4150
1— 500	G.E.	720	600	13200
1— 400	G.E.	720	250	2300
1— 200	G.E.	720	125	440

BELYEA COMPANY, INC.
51 Howell Street, Jersey City, N. J.

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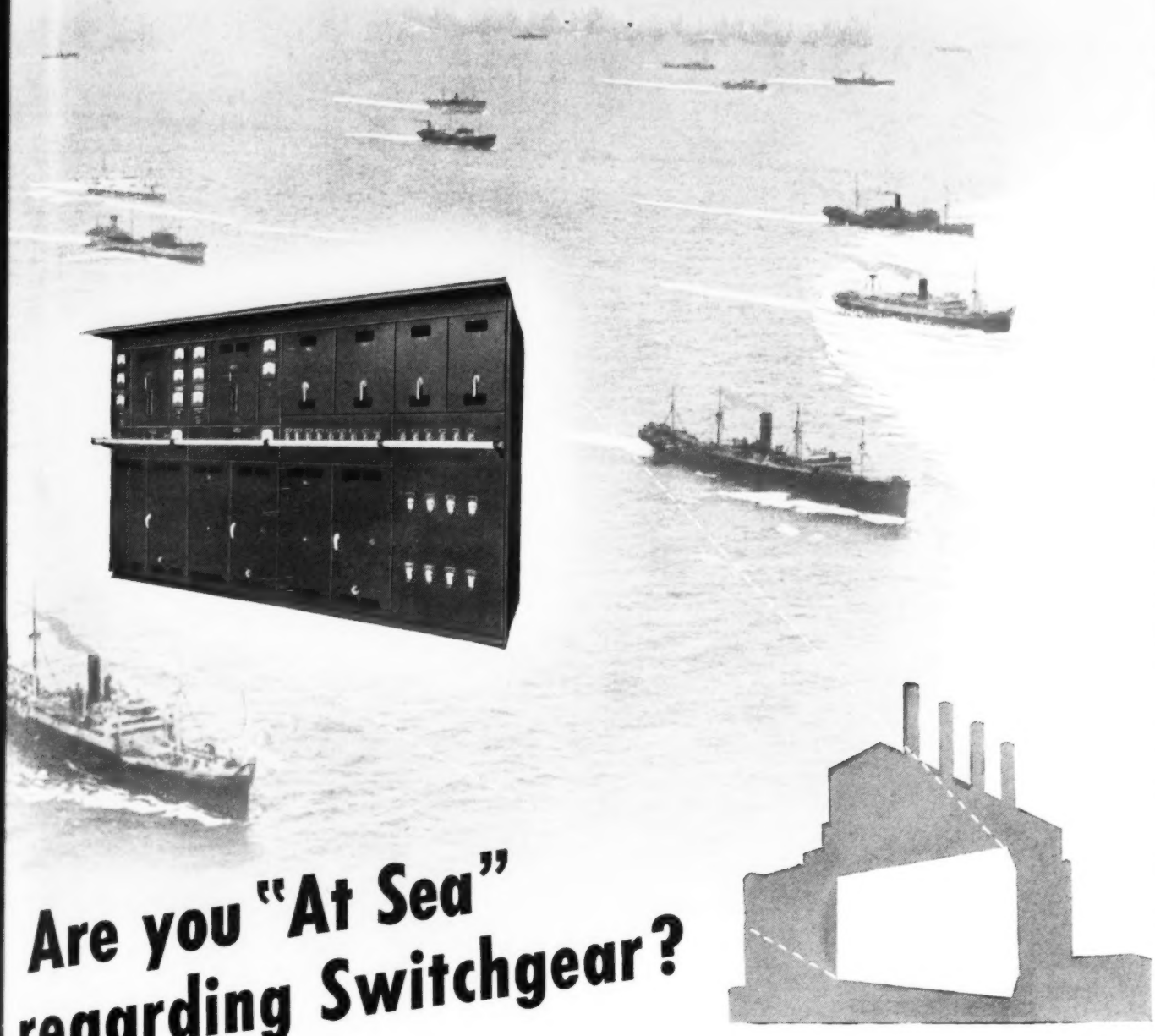


Are you "At Sea" regarding Switchgear?

Literally speaking, we are "at sea" because the Navy has long depended upon I-T-E for circuit breaker protection. Even when Theodore Roosevelt sent the Great White Fleet around the world, it was equipped throughout with I-T-E air circuit breakers, and in World War I, our fleet was similarly protected. This heritage imposed a tremendous load on us when World War II started because protection by air switchgear has continued to be a basic requirement for merchant marine as well as fighting ships.

We are also "at sea" in another way. While building for the Navy we can not adequately serve all our customers old and new. Even though our facilities and manpower have been doubled, and doubled and doubled, deliveries to industry are limited to a few top priorities. This has been a matter of great concern to I-T-E and we look forward to the day when we can again supply your switchgear requirements. Until then, all our resources must be devoted to filling the nation's most urgent war needs. However, don't hesitate to call upon us now for assistance and information regarding switchgear and its application.

HIGH SPEED
CIRCUIT BREAKERS

AUTOMATIC RECLOSING
CIRCUIT BREAKERS

UNIT SUBSTATIONS

SWITCHGEAR

BUS STRUCTURES

I-T-E

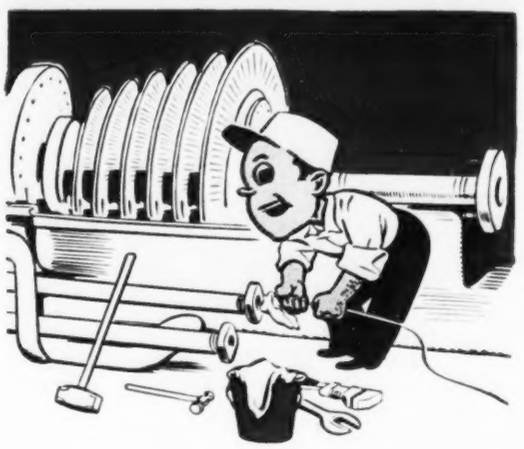
AIR SWITCHGEAR

I-T-E CIRCUIT BREAKER CO.

19th and Hamilton Streets Philadelphia 30, Pa.

LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . .

Make the next time the last time you ever need to clean oil deposits from a turbine



NONPAREIL TURBINE OIL

WHAT WOULD you save if you eliminated cleaning turbine oil systems?

Naturally, the first items of expense for cleaning deposits from a turbine are labor, down-time, materials, and loss of oil. Over a period of years, these costs amount to a sizable total.

But there is another item that cannot be measured in dollars and cents. It's the all-important safety factor. When the need for cleaning turbine oil systems is entirely eliminated, so are the hazards of stopped oil passages to bearings and governors, the dangers of high oil temperatures, excessive acidity increase, and poor oil demulsibility.

Nonpareil Turbine Oil eliminates the formation of all deposits caused by oil deterioration in turbines. All asphaltene-formers have been removed from Nonpareil and the oil stabilized against dangerous acidity increase *for the life of your turbine*. This means, that once Nonpareil is installed, you not only *do not have to clean* turbine oil systems, but you *never need to remove* Nonpareil for treating, resting, or cleaning because of oil deterioration.

Make the *next* time the *last* time you clean a turbine oil system—put in Nonpareil Turbine Oil. Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

Buy more War Bonds

STANDARD OIL COMPANY (INDIANA)

STANDARD SERVICE